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REFINERY MARCH 25, 1943 NUMBER

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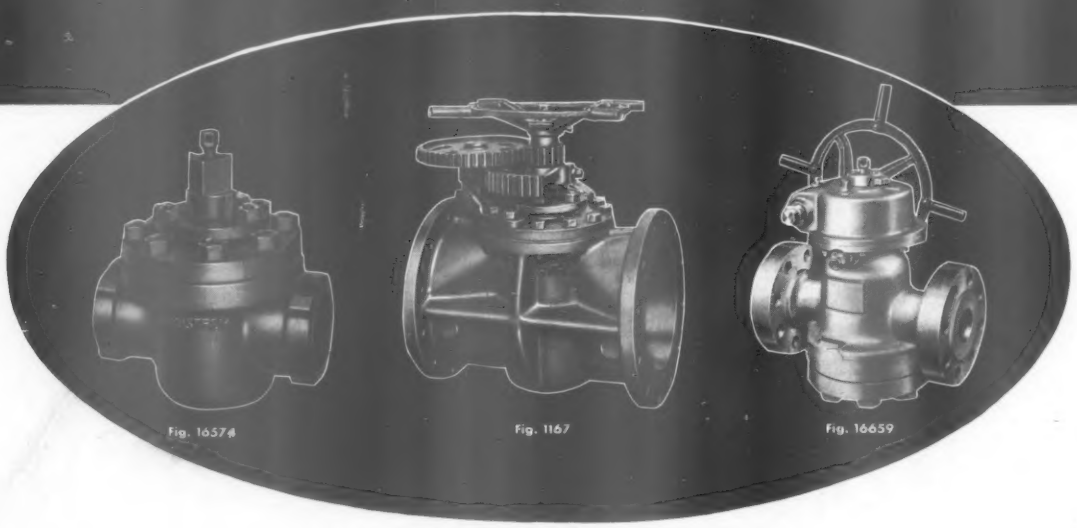

Fig. 16574 Fig. 1167 Fig. 16659

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Research finds the way

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the OIL AND GAS JOURNAL

Trends

Crude-Oil Production
By States — Page 346

CRUDE PRODUCTION 3,942,900 bbl. daily average—up 64,720 bbl. One year ago 3,681,470 bbl.

CRUDE STOCKS 236,655,000 bbl. as of March 13—up 969,000 bbl. One year ago 262,063,000 bbl.

GASOLINE STOCKS 93,279,000 bbl. as of March 13—up 434,000 bbl. One year ago 109,281,000 bbl.

RESIDUAL FUEL-OIL STOCKS 68,243,000 bbl. as of March 13—down 539,000. One year ago 84,730,000.

GAS OIL AND DISTILLATES 31,113,000 bbl. as of March 13—down 555,000. One year ago 32,042,000.

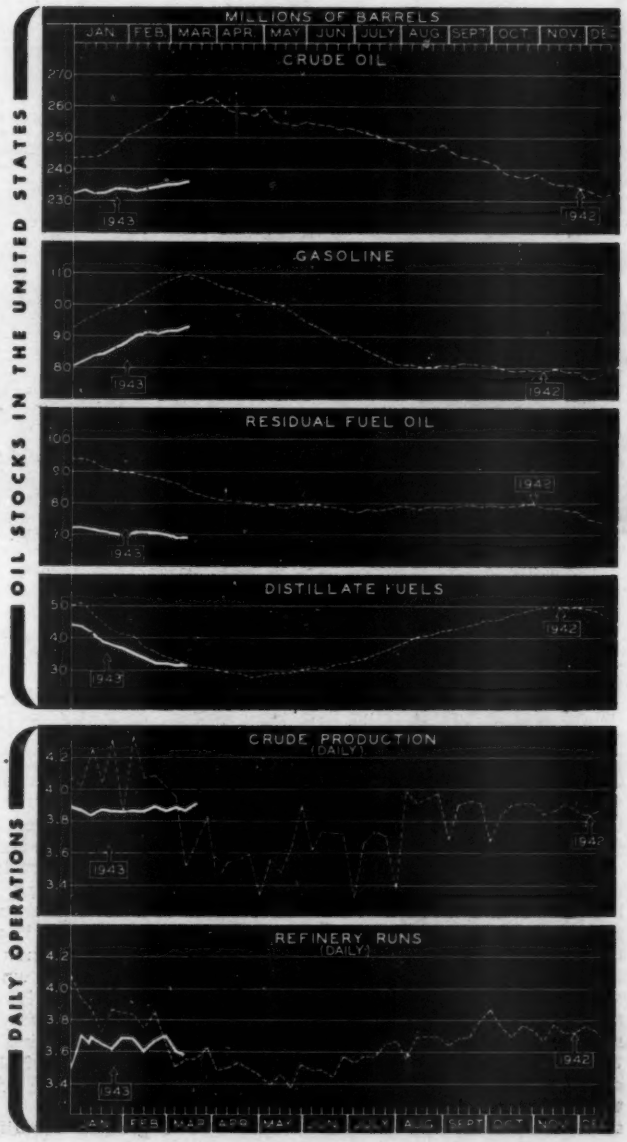
REFINERY RUNS 3,579,000 bbl. daily week ended March 13—down 47,000. One year ago 3,568,000 bbl.

Refinery report delayed.

PETROLEUM refiners in the United States will start what is commonly referred to as the "main gasoline-consuming period of the year" on April 1 with the lowest stocks of motor fuels as of that date since 1939. Contrary to the predictions the latter part of last year when the national rationing of gasoline became effective, there has been no general accumulation of excess motor-fuel. In fact most refining centers are concerned as to how they will take care of the civilian and military requirements through the spring and summer months.

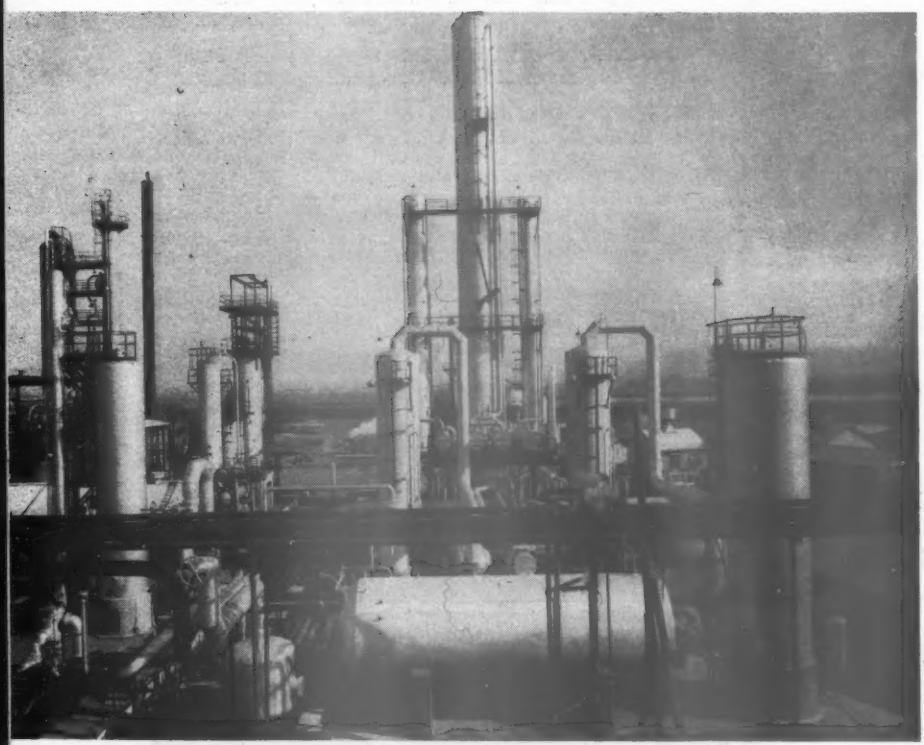
THE chart and table on this page reflect the national situation in regard to stocks which finds gasoline on hand at refineries, major terminals, in transit, and in pipe lines about 16 million barrels less than on the corresponding date in 1942. Comparing the A.P.I. report for the week ending March 13 this year with March 14, last year, reveals that this year's decline is more pronounced when California is separated from the remainder of the country. Gasoline stocks in the West Coast states due in part to the recent curtailment in export shipments are 3,300,000 bbl. greater than they were a year ago and reports recently have indicated that some refiners have excess stocks of the regular grades.

FOR the remainder of the country gasoline stocks are about 17½ million barrels or 20 per cent less than they were a year ago. In the censored area consisting of the East Coast, Texas, Louisiana, and Arkansas, stocks are 10 million barrels less. Stocks on hand in the East are particularly low, a condition brought about by the necessity in recent months of maintaining maximum shipments of distillates and fuel oils to that area. In the inland areas compared to a year ago the stock declines are: Middle West, 10 per cent; Rocky Mountains, 13 per cent; and Oklahoma, Kansas and Missouri, nearly 30 per cent. While the gasoline stock positions of these inland refineries vary the problem of most of them is how they will take care of their gasoline customers over the next few months and at the same time maintain a production of fuel oil and distillate which will provide current needs and at the same time build up stocks for the fall and winter requirements. Crude runs to stills at inland refineries are slightly higher than they were a year ago with a 25 per cent increase in California. The increases are offset with a decline of more than 200,000 bbl. daily in runs at plants within the censored area.



Expansion of Catalytic Processing Year's Feature in Refining

by J. P. O'Donnell



Hydropolymer plant at the Richmond, Calif., refinery of Standard Oil Co. of California, looking east

Approximately 80 catalytic-cracking units at refineries of 34 companies have already been installed or approved, a growth of 76 since the start of 1941. While these have been built primarily to satisfy war demands, they are destined to play an important postwar role.

NEW YORK.—Rapid expansion of catalytic-cracking capacity, elevating this tool of refining to a topmost position, both in the manufacture of war products and in the production of postwar motor fuels, probably was the outstanding development in this branch of the industry during the past 12 months.

Installation or approval for construction of nearly 80 catalytic-cracking units at refineries of 34 companies connotes the scope of acceptance for this instrumentality for manufacture of 100-octane motor fuels and other war products. The current program attains added significance in comparison with the fact that, at the start of 1941, there were only 14 catalytic-cracking units operating in this country, all concentrated at refineries of three companies.

Development of catalytic cracking is currently confined to units of large capacity, chiefly because of the economies accruing to volume operations and the more frugal expenditure of steel and other critical products.

The trend to larger units is one of the reasons for certain changes in the general picture this year in petroleum-refining operations. There are 39 fewer operating plants in the United States this month but their crude-oil capacity is about 6,500 bbl. per day greater than at the end of March 1942, as shown in accompanying tables summarizing the Journal's annual refinery survey. There were 412 active refineries in the United States at the end of March with combined capacity of 4,780,025 bbl. of crude daily.

The greater versatility of modern refineries equipped with catalytic-cracking plants and other advanced facilities also appears to be a factor, along with maladjustments in crude supplies and transportation accuterments, in the increase of idle refineries. Restrictions on the consumption of products and generally lower runs to stills which has prevailed since January 1942, probably is the main reason why the country now contains 84 idle refineries whereas at the same time last year there were only 74 inactive plants. Furthermore, the total number of plants in the country has dwindled from 525 to 496. Some of the equipment from dismantled refineries has been diverted to maintenance, repair and expansion functions at operating plants but a high percentage of towers, valves, pumps and other supplies needed for catalytic-cracking units are new and designed to give highly efficient service.

Aviation Fuels Critical

The succession of events in the development of new refining processes gives proof enough of the pace at which the industry is moving to provide United Nations' air forces with the best aviation fuels attainable. New catalysts, new processes, conversion of a combination of old with new processing methods have followed rapidly on the heels of earlier achievements, themselves outstanding in refining technology. These results crowded into 2 or 3 years the advances which might be expected in as many decades of peacetime development.

When the war broke out, 100-octane capacity in the United States, one of the cardinal objectives of catalytic cracking, totaled 10,000 to 15,000 bbl. per day. When hostilities started, the United Nations, under the pressure of emergency, began to expand capacities for manufacture of aviation fuels. The 1939 productive capacity has been multiplied many times and will continue upward to a figure that was previously considered fantastic.

The catalytic-cracking units, reviewed here from the aspect of showing the scope of this development, to give an impression of how prominently the art will figure in prosecution of the war and its impact on postwar refining, do not include any of the several other catalyst processes. Catalytic alkylation, isomerization, cyclization, hydrogenation, dehydrogenation and polymerization are other processes which are also being used to synthetize various aviation-fuel components.

This increase in production of 100-octane fuel called for greater quantities of base stock, blending agents and tetraethyl lead, the components of today's fighting grade aviation fuels. The principal source of base stock is catalytic cracking. At the end of 1940, there were only 14 catalytic-cracking units in operation in this country, 9 owned by Socony-Vacuum Oil Co., Inc., and its subsidiary, Magnolia Petroleum Co., and 5 by Sun Oil Co. Only two others were under construction. All of these units employed the Houdry process which had been announced 2 years earlier.

TABLE 1—Catalytic-Cracking Plants

	No. and type of units*			
	Houdry	Fluid	T.C.C.	Ttl.
Abercrombie & Harrison	..	1	..	1
Ashland Oil & Ref.	..	..	2	2
Atlantic Ref. Co.	..	2	..	2
Cities Service Oil Co.	..	3	..	3
Continental Oil Co.	..	..	3	3
Cooperative Refinery	..	1	..	1
Crown Central Pet.	..	..	2	2
Eastern States	..	1	..	1
Frontier Ref. Co.	..	1	..	1
General Pet.	..	..	4	4
Gulf Ref. Co.	1	..	3	4
Gulfport Ref. Co.	1	..	..	1
Humble Oil & Ref. Co.	..	2	..	2
Magnolia Pet. Corp.	4	..	2	6
National Ref. Co.	..	1	..	1
Pan-American Ref.	..	1	..	1
Pennzoil Co.	..	1	..	1
Pure Oil Co.	..	..	2	2
Republic Oil Ref. Co.	..	1	..	1
Root Ref. Co.	..	1	..	1
Shell Oil Co., Inc.	..	3	..	3
Sinclair Ref. Co.	1	2	1	4
Socony-Vacuum Oil Co.	7	..	1	8
Standard Oil of Calif.	1	..	..	1
Standard Oil of Ind.	..	1	..	1
Standard Oil of La.	..	3	..	3
Standard Oil of Ohio	2	..	..	2
Standard Oil of N. J.	..	2	..	2
Sun Oil Co.	7	..	..	7
Terminal Ref. Corp.	1	..	..	1
Texas Co.	..	2	..	2
Tide Water Asso. Oil	1	..	..	1
Utah Oil Ref. Co.	..	1	..	1
Wilshire Oil Co., Inc.	..	1	..	1
Total	26	31	20	77

*Note: Additional plants are being approved in this program.

TABLE 2—Breakdown by Types

Process—	Built	Building	Total
Houdry	16	10	26
Fluid	3	28	31
T.C.C.	0	*20	20
Total	19	58	77

*Includes two units which have been approved but which are not yet under construction.

War Speeds Development

Acceleration of the national defense program in 1941 including an increased demand for fighting grade aviation gasoline developed the need for additional catalytic-cracking capacity. This need further speeded developments that were then under way and since then two new processes have been introduced, the Fluid type which was developed by the Standard Oil Co. of New Jersey and disclosed publicly for the first time in February 1941, and the T.C.C. (Thermofor) which was developed by Socony-Vacuum and announced in June 1942. These processes were all made available to the entire industry and each is now sharing in the aviation gasoline program. The extent is shown in Table 1, listing the number of units built and building. It is estimated that the completion of the program as it now stands will raise the charging capacity of the catalytic-cracking plants to approximately four times the capacity as of January 1, 1941.

In addition to the increase in capacity there has been a great diversification in the number and location of the refineries participating. Then there were only three companies equipped with catalytic-cracking facilities, Sun, Socony-Vacuum and the latter's subsidiary, Magnolia. Now there are 34 companies which will have a total of 77 units when the current program is completed (see Table 2). The continuing increase in demand for 100-octane gasoline makes it certain that both the number of units and the total capacity will be expanded even further.

Besides the increase in the number of plants there have been other significant developments that have resulted in greater yields of better quality base stocks. For example, yields and quality of products from completed plants have exceeded preconstruction estimates by sizable margins. There have also been process changes such as the recent development of a new synthetic catalyst by Socony-Vacuum which have improved yields from the standpoint of quality as well as quantity. While this cata-

Butadiene plant of Standard Oil Co. of Louisiana

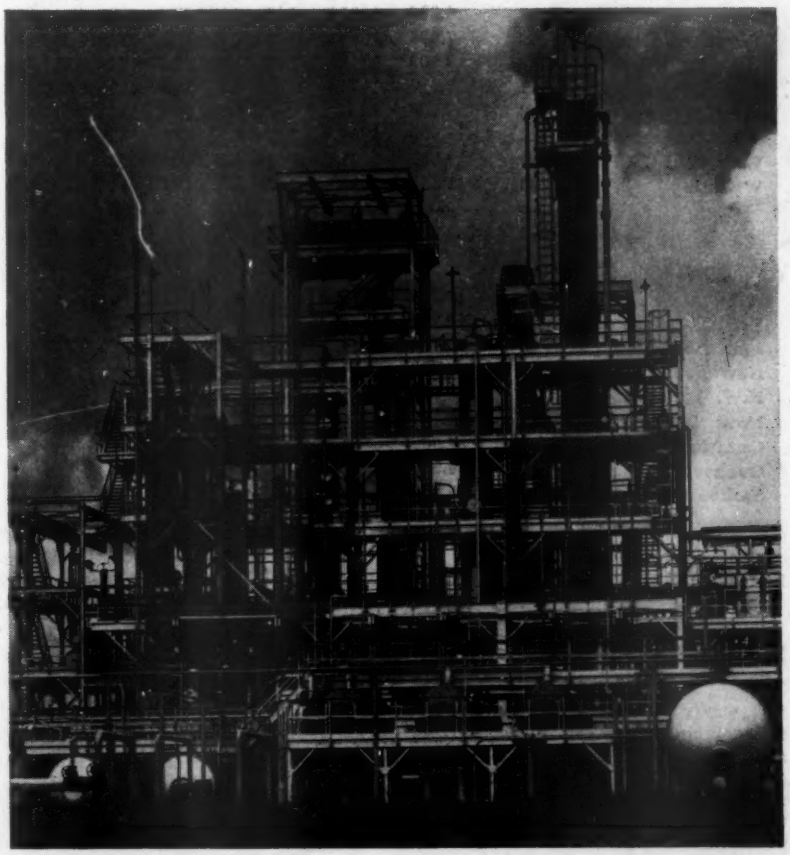


TABLE 3—Refineries Operating in North America

	No.	Dly. crude capacity (bbl.)
UNITED STATES:		
Alabama	1	4,000
Arkansas	6	44,000
California	52	812,150
Colorado	7	13,825
Delaware	1	3,500
Georgia	1	4,000
Idaho	2	2,500
Illinois	20	286,950
Indiana	9	243,100
Kansas	22	187,800
Kentucky	9	57,450
Louisiana	14	222,700
Maryland	3	42,500
Massachusetts	2	54,860
Michigan	20	94,000
Minnesota	2	7,500
Missouri	2	25,100
Mississippi	2	7,000
Montana	13	37,605
Nebraska	8	9,650
New Jersey	5	238,200
New Mexico	8	9,550
New York	6	60,000
Ohio	9	190,500
Oklahoma	25	213,330
Pennsylvania	28	369,500
Rhode Island	2	9,000
South Carolina	1	6,000
South Dakota	4	400
Tennessee	1	4,800
Texas	90	1,417,000
Utah	3	12,500
Virginia	1	2,000
Washington	2	6,000
West Virginia	4	15,000
Wisconsin	1	5,000
Wyoming	26	61,055
Total	412	4,780,025
CANADA:		
Alberta	14	19,250
British Columbia	4	43,200
Manitoba	5	3,750
New Brunswick	1	300
N.W. Territories	1	850
Nova Scotia	1	32,500
Ontario	6	67,600
Quebec	5	64,800
Saskatchewan	10	15,500
Total	46	247,750
MEXICO:		
Total	12	150,495
NORTH AMERICA	471	5,178,270

lyst was developed by engineers interested in the T.C.C. process it is also suitable for use in the Houdry process and will result in an improvement in Houdry products comparable to that experienced in the T.C.C. products.

One reported result of these improvements is a reduction in the volume of blending agents needed to obtain 100-octane. It has been stated that at one time blending agents represented from 60 to 75 per cent of the finished gasoline whereas now this proportion has been reduced to 20 to 35 per cent. The principal source of blending agents is the alkylation process combining isoparaffins with olefins to produce an agent high in lead susceptibility. There is sufficient production of olefins for alkylation from these catalytic-cracking processes to make refineries employing them virtually self-sufficient for the production of 100-octane gasoline.

A matter of common conjecture is the postwar role of the catalytic-cracking units that are being built now to satisfy war demands. One of the most significant facts is that such plants operated economically before the war and in view of the probability that there will be a demand for more gasoline of a better quality after the war it is likely they will be at least equally economical then. There is the additional and very important fact that yields of gasoline from crude oil are materially increased by the use of these processes. This conservation factor looms increasingly important as a result of the decrease in the rate of crude-oil discoveries.

TABLE 4—Growth of Refinery Capacity in the United States

	All plants		Operating plants	
	No.	Capacity (bbl./day)	No.	Capacity (bbl./day)
1914	176	.....	.....	.....
1918	267	1,186,155	.....	.....
1919	289	1,295,115	.....	.....
1920	373	1,530,565	.....	.....
1921	415	1,888,800	.....	.....
1922	479	2,164,050	325	1,854,590
1924	574	3,046,790	362	2,549,490
1925	584	3,033,682	385	2,680,052
1925	515	3,068,340	356	2,770,340
1927	462	3,224,307	328	2,964,427
1928	456	3,426,330	315	3,116,930
1929	463	3,719,550	341	3,454,250
1930	479	3,972,460	362	3,721,360
1931	500	4,164,080	397	3,913,180
1932	510	4,093,370	383	3,665,830
1933	567	4,125,250	424	3,696,410
1934	628	4,243,033	483	3,790,593
1935	687	4,281,694	496	3,815,470
1936	640	4,301,754	479	3,936,535
1937	603	4,277,860	471	4,038,010
1938	562	4,511,160	451	4,301,910
1939	560	4,461,120	465	4,191,055
1940	534	4,665,318	462	4,438,658
1941	548	4,816,715	459	4,524,775
1942	525	5,019,815	451	4,773,635
1943	496	5,043,010	412	4,780,025

Refinery Section

The technical section of this Annual Refinery Number starts on page 81. Particular emphasis has been placed on how the industry's refinery units are serving the nation's war effort. The articles, each written by an authority in his field, cover a wide range of subjects. In addition, the section contains The Journal's survey of plants, starting on page 231, and a buyers' guide of plant equipment, starting on page 241.

Eastern Gasoline Ration Is Halved

WASHINGTON, D. C. — Basic gasoline rations in the 17 eastern states and the District of Columbia were cut in half this week as OPA, acting on recommendations from the petroleum administrator, extended the valid period for A-5 coupons from 2 months to 4 months.

By limiting motorists who have no occupational use for their cars to 90 miles a month, the cut in basic ration will retain the saving achieved through the pleasure-driving ban which had been in effect since January 7.

Deflated value of coupons will, OPA anticipates, have approximately the same restrictive powers as the enforced prohibition against pleasure driving and will require much less policing.

Car owners who have been using their A books for occupational purposes will become eligible for supplemental rations under provisions of an amendment to the regulations, details of which will be announced in a few days. Petroleum Administrator Ickes certified that only 333,000 bbl. of gasoline daily could be made available for East Coast civilian and industrial use during April.

For the month of April, PAW advised OPA, there will be 1,013,000 bbl. per day of petroleum products available for East Coast consumption compared with 1,108,000 bbl. in March; 1,142,000 bbl. in February and 1,171,000 bbl. in December 1942.

Indicated East Coast Supply

Product—	April	March
Motor fuel	333,000	312,000
Kerosene	125,000	155,000
Distillate fuel	286,000	350,000
Residual fuel	269,000	285,000
Total	1,013,000	1,108,000

The figures do not include supplies for direct military use, either for operations in this country or offshore movement.

The mass spectrometer in action. This amazing instrument, which is expected to accelerate the manufacture of aviation gasoline and synthetic rubber stocks, by making possible more minute analysis of hydrocarbons, is shown being operated at the Philadelphia refinery of Atlantic Refining Co. Seated at the panel board is Dr. O. L. Rob rts, Atlantic; standing, H. F. Wiley, Consolidated Engineering Corp.

THIS WEEK

REFINING—Growth of catalytic cracking—63 plants built or authorized since start of war—charts unmistakable course for manufacturing. . . . ¶Shortage of crude hampers maximum output of war products, by eastern refiners. . . . Middle West crude shortage endangers ability of District 2 refiners to meet minimum essential gasoline requirements, maintain supplies of fuel and build stocks for next winter. . . . Aviation gasoline still biggest problem, for immediate future. . . . Projected productive goal elevated again. . . .

TRANSPORTATION—Third big-inch line bobs up again, this time in Administrator Ickes' letter to a congressman. . . . No specific plans revealed, pending action on request for eastern extension of 20-in. products system. . . . ¶PIWC transportation committee forecasts minimum eastern petroleum deliveries, by fall, of 1,600,000 bbl. daily, possibly 1,730,000, IF products-line extension gets the nod. . . . ¶Insufficient tank cars provided at Norris City, Ill., terminal of 24-in. to use maximum capacity. . . . ¶Pan American Pipe Line Co. starts northern movement of refined products through reversed crude carrier, for delivery to WEP at Longview. . . .

RATIONING—Eastern A coupons devalued, by doubling valid period. . . . Police enforcement of nonessential driving abolished, lower rations substituted. . . . OPA considering entire fuel-oil ration plan, preparing for next winter. . . . Changes almost certain. . . .

RUBBER—Tire quotas for April raised, some classes as much as doubled . . . Low mileage drivers qualified to purchase Grade 2 casings. . . .

PRODUCTION—Alarming decline reported in productive capacity of District 2 oil states. . . . Output may fall to 800,000 bbl. daily, even lower rate is not impossible, by first quarter next year. . . . ¶Administrator Ickes, Deputy Davies deny PAW has any intention of arbitrarily controlling wildcat locations. . . . Formal statement of denial issued, countering interpretation placed on utterances of two assistant deputy administrators. . . . ¶PAW certifies production quotas for April, averaging 4,186,100 bbl. daily, down 7,700. . . .

SUPPLIES—Companies now dividing crude in Middle West may cease outside deliveries April 1. . . . PAW directive to refiners carried no specific time limit. . . . Many Middle West refiners still short of requirements, even with help from other purchasers, pipe-line companies. . . . ¶PAW again frowns on West Texas sour crudes, says war supplies too critical to warrant change. . . .

GOVERNMENT—Postwar thinking and some of the policies that are so far nebulous but none the less indicative of a trend, strike pretty directly at the oil industry. . . . Disposition of government-owned plants is the big question. . . . Vice President Wallace has enunciated opposition to postwar tariff protection of synthetic rubber, favors conversion of producing units to other services—UNLESS they can compete with natural product, strictly on an economic basis, . . . ¶Rumor is that government participation in pipe lines is a long-term probability, involving federal voice in extensions, ownership, management, operation. . . . ¶Patman small business committee certain to hear much about crude prices in Washington, April 14, 15 and 16. . . .

Crude Prices to Figure In Patman Hearings

WASHINGTON, D. C. — An investigation of conditions affecting petroleum production and particularly restrictions on wildcatting by smaller operators, has been scheduled by the House committee on small business to start April 14.

Rep. Wright Patman of Texas, chairman of this committee, announced that his group will pay special attention to the causes of the decline in exploratory drilling and government policies and regulations which impede wildcatting.

While the subject of the price of crude oil was not mentioned in the official announcement of the hearings, several members of the committee expressed the belief this angle undoubtedly will come in for considerable discussion. Because of the complaints throughout the producing end of the oil industry that the present price ceiling on crude is the most important factor in the current low rate of new discoveries, the committee can be expected to hear a considerable volume of testimony on this subject.

Independents Invited to Testify

An open invitation has been issued to all industry witnesses who wish to appear, particularly the smaller independent drillers. No government officials have been asked to testify as yet but representatives of the Petroleum Administration for War and the Office of Price Administration are expected to testify. The committee has not made a staff investigation of oil production and will not have any tentative report before it, and will develop its information from the testimony of witnesses.

The subject of government subsidies to stimulate drilling is also likely to be raised in the course of the hearings, and considerable attention will be given to the supply of steel and other materials available to independent operators.

The Patman small business committee has conducted a number of special investigations during the past 2 years, chiefly concerning itself with problems of distributors and with the effect of the war on smaller manufacturers, but this is the first time it has turned its attention to the oil industry. Oher phases of the oil industry than production may be covered by the hearings, but committee attaches do not expect the investigation to cover marketing and the problems of the independent distributor at this time.

The hearing will be held in the Caucus Room of the old House Office Building, and it is expected that it will occupy 2 or 3 days. Numerous men from the petroleum industry, representing the principal oil-producing sections of the nation, will be asked to appear. Representatives of war-emergency agencies also will be questioned.

"We want to obtain a comprehensive view of the oil-supply situation in national terms," said Mr. Patman. "The numerous appeals of the petroleum administrator and his staff for more wildcat drilling and the obvious fact that we are using up our oil reserves much faster than we are finding new ones point to an alarming condition. The smaller operators are not responding to these appeals. Representations to members of Congress indicate that there are grave omissions in the national program of emergency regulations which prevent the exertion of the necessary effort on the part of the small producers who usually have found most of the new oil sources in any given year.

"Members of the committee on small business agree with me that the time is here to find out where the trouble lies and to do all we can to correct it. We must have the oil."

The committee, in addition to Chairman Patman, is composed of Estes Kefauver, Tennessee; Eugene J. Keogh, New York; J. W. Robinson, Utah; Henry M. Jackson, Washington; Charles A. Halleck, Indiana; Leonard W. Hall, New York; Walter C. Ploeser, Missouri; and William H. Stevenson, Wisconsin.

Ickes Allays Fear That PAW Plans to Dictate Exploratory Locations

WASHINGTON, D. C.—Fears of oil men that the Petroleum Administration for War was preparing to exercise arbitrary jurisdiction over the location of exploratory wells was countered last week by direct refutation of any such plan by Administrator Ickes and Ralph K. Davies, deputy.

Certain utterances and requests for geological information by members of the PAW staff had been construed by representatives of the industry to be the forerunners of centralizing control at Washington over exploratory operations. Virtually all elements in the producing branch of the industry have expressed their opposition to any extension of Washington authority over the location of exploratory operations and the statements last week by Administrator Ickes and Deputy Administrator Davies were obviously issued to dispel these fears, whether real or fancied.

"Unwarranted apprehension," declared Mr. Ickes, "has been expressed by certain members of the industry that the Petroleum Administration for War intends to exercise discriminatory judgment with regard to the drilling of wildcat wells. I contemplate no such action. My office has done everything within its power to avoid any restriction upon the exploratory effort of the oil industry. I propose to continue this policy."

Recently, Administrator Ickes called for the drilling of at least 4,500 wildcat wells during 1943, 50 per cent more than were ever drilled before in any single year.

During the past few years the rate of production has exceeded the rate of discovery of new oil fields.

Exploratory Importance Emphasized

Importance of exploratory drillings was emphasized by Deputy Petroleum Administrator Ralph K. Davies. He stated:

"Exploration is more important today than it ever has been. We must find new oil fields at an increased rate if we are to continue to have a productive capacity equal to our needs.

"We are not concerned with the estimates of reserves made up largely of revisions. Our reserves are sufficient; it is our daily productive capacity that may fail.

"The quickest method of increasing the productive capacity of this country substantially is through the discovery of new fields.

"The Petroleum Administration for War proposes to do everything within its power to promote the drilling of an adequate number of wildcat wells. Where these wells will be drilled will be left, as it always has been, to the discretion of the wildcatters."

THIRD BIG-INCH LINE POSSIBLE

WASHINGTON, D. C. — The possibility of a third big-inch pipe line has been raised publicly for a second time by Administrator Ickes, but PAW transportation men say not even preliminary planning has been done as to the possible size, location, timing and character of such a project.

Some 3 months ago Administrator Ickes told a Senate committee not to be surprised if he requested steel for a third pipe line within a year "if we want to be 'dead sure' of meeting all East Coast essential and offshore military demands."

He raised the point again this week end in a letter to Rep. J. Buel Snyder of the House committee on appropriations regarding construction of a trans-Florida barge canal in which he declared that barges and tugboats would use steel for the delivery of oil with only about 55 per cent of the efficiency of a large pipe line.

Explaining that the two lines now building will have a capacity of 535,000 bbl. daily, he said: "Yet, even then, we do not feel justified in saying that we shall have solved the problem. We do not feel justified in so saying because neither we nor anyone else knows what the demands of war may be. We consider it quite within the realms of possibility that a third big pipe line might be found to be necessary."

Pending 20-in. Decision

Pipe-line authorities feel that even if Mr. Ickes believes a third line inevitable he will not start a preliminary study of routes and capacity until WPB approves the eastern end of the 20-in. and construction on it is well under way.

Meanwhile, progress is being made toward actual construction work on the western leg of the 20-in. Defense Plant Corp. has tentatively approved contractors for 10 spreads and is expected to sign laying contracts within a few days. Crews were making ground surveys south of Little Rock, Ark., this week. Orders have been placed for all pipe, pumps, motors, and valves, and manufacturers have scheduled their shop work so that deliveries are promised in time to get the line in operation on September 1.

National Tube Co. will make 200 miles of 20-in. pipe; Youngstown Sheet & Tube Co., 345 miles, and A. O. Smith 290 miles, a total of 835 miles.

Approximately 40 miles of pipe is scheduled for shipment during March, 95 miles in April, and the balance by July. One hundred thirteen special valves are scheduled for completion during July. Pump contracts have been let to Allis-Chalmers and Ingersoll-Rand, and motor contracts to General Electric and Westinghouse. In addition to the 20-in. pipe there will be 62 miles of 16-in. between Baytown and Beaumont, two 8-in. feeder lines to Baytown totaling 56 miles, and several short 8, 10 and 12-inch feeder lines near Beaumont.

Pan American Reversed Line Starts Moving Products North

HOUSTON, Tex.—The active participation of Pan American Pipe Line Co. in the war emergency effort to deliver needed refined petroleum products to the East Coast began this week when the company's new station at Texas City, Tex., the southernmost point from which refined products move to the East Coast, was placed in operation.

In order to deliver refined products to the East Coast via the WEP 24-in. line, it was necessary for Pan American to reverse the flow of their 224-mile 12-in. crude line between Longview and Texas City. This line was formerly used for transportation of crude from the East Texas area to its refinery at Texas City. War Emergency Pipelines, Inc., has constructed some 7 miles of 16-in. line which connects the Pan American 12-in. reversed system with WEP's 731-mile 24-in. line from Longview to Norris City, Ill. An extension of the 24-in. line is now under construction which will give WEP outlets at Marcus Hook (Philadelphia, Pa.), and Bayonne, N. J., thus completing a system through which products will be moved 1,774 miles.

By a directive from the petroleum administrator for war, Pan American's Texas City-Longview line serves as a carrier, and will move not only products from the company's refinery at Texas City, but also those products gathered from the plants of Humble Oil & Refining Co., Sinclair Refining Co., Crown Central Petroleum Corp., Republic Oil & Refining Co., and Maritime Oil Co. The reversed Pan American system has a daily capacity of 50,000 bbl. of products.

The other outlet from Pan American's Texas City station to the East Coast is provided by the Bayou-Plantation Pipe Line system. The 6, 8 and 10-in. Bayou line from Texas City through Baytown, Tex., to Baton Rouge, La., connects with the Plantation system at Baton Rouge. The

(Continued on Page 75)

P. J. Sweeny, manager of Pan American Refining Corp., and E. R. Turner, vice president, Pan American Pipe Line Co., opening intake and discharge lines to start flow of refined products through Pan American's reversed line delivering to WEP 24-in. system in East Texas. Behind Messrs. Sweeny and Turner are: H. J. Broderson, general superintendent, Texas City refinery; J. E. O'Riordan, master mechanic; A. J. Rabe, general superintendent; F. E. Richardson, manager; O. L. Williams, Texas City station engineer, all of Pan American Pipe Line Co.

State Capitals

TEXAS

THE LEGISLATURE has under consideration seven bills affecting the state's oil industry. The session has passed the halfway mark and observers believe that due to confused conditions, oil will receive but scant attention.

The measures are as follows:

Prevention of pipe-line proration, or selective buying. Representative Sadler reports that he has received favorable reaction to this bill, which he has proposed.

Increasing the oil production tax to 6 cents a barrel, which would impose $11,000,000 additional burden on the oil industry. This bill is causing more disturbance than any other.

Placing a tax on all refined gasoline whether intended for intrastate or interstate traffic, which would amount to approximately $50,000,000 a year.

Establishing a state-wide policy for unitizing all oil fields and pools on privately owned properties. While this bill provides for voluntary agreements, opponents argue that about the only firms that can take advantage of the policy will be the major companies.

Establishing a state-wide policy for unitizing or pooling all leases producing on lands where the state owns the mineral rights.

Requiring that no lease contract shall be entered into without approval of the land commissoner and state mineral board.

Creating a new oil and gas commission, taking supervision away from the Railroad Commission. This bill, offered in the senate and not yet set for a hearing, provides for an entirely new setup. The three proposed commissioners would only serve part time but would be authorized to appoint a director. To date but little interest has been manifested in this measure.

ILLINOIS

ASSERTING that a boost in the ceiling price on crude oil is necessary "as an incentive to stimulate discovery of new fields," the oil conservation committees of the Illinois house and senate have approved a resolution under which Illinois would join Texas and Oklahoma in petitioning Congress to raise the ceiling price.

The resolution does not, however, carry any recommendation as to how high above the ceiling price of $1.375 a barrel the price should be raised. An objection to a suggestion that the price be boosted to $1.50 was raised by one legislator who said that "a 13-cent increase in the ceiling price would not be sufficient to spur production of oil."

Another legislator opposed the resolution with the declaration that "independent oil companies can make plenty of money at $1.375 a barrel."

Setting out that demands of mechanized warfare are responsible for depletion of oil reserves, the resolution declares that consumption is steadily increasing with estimates that 4,000,000 bbl. daily will be needed during the last part of this year.

"Some incentive to stimulate discovery of new fields," the resolution points out, is urgently needed and raising the ceiling price would provide such incentive by inducing prospectors to expand their operations if assured this opportunity for obtaining a reasonable return on their investments."

ARKANSAS

DEVELOPMENT of three oil and gas fields in Arkansas is due for an airing before the Petroleum Administrator for War and the State Oil and Gas Commission at Magnolia, Ark., April 6. The fields are Dorcheat, Macedonia and McKamie.

Original production in all three of the fields was found in the Smackover limestone at a maximum depth of 9,500 ft. This formation is normally productive of condensate or distillate with relatively small volumes of hydrogen sulfide bearing gas. Plants for the purification of the gas are under construction and the sweet gas is pledged for use at war industries and military facilities. All of the fields are closed to production, awaiting a market for gas.

Due to the fact that the fields were originally of a gas type, they came under the jurisdiction of the Natural Gas Division of the Petroleum Administration for War at Washington, D.C. This bureau agreed to the spacing of wells at one well to each 80 acres for Dorcheat and Macedonia and one well to each 160 acres for McKamie. However, early this year the bureau refused to grant any further permits for the drilling of wells, alleging that sufficient wells had been drilled to supply the demand for gas. This action has made further drilling impossible.

Early in March of 1942, the Cotton Valley formation was found productive in the three fields and proved a potential source of both oil and gas from 6,000 to 8,600 ft. On June 1, 1942, the Oil and Gas Commission gave the operators permission to produce the oil and gas found in the newly discovered horizon by dually completing wells drilled to the lime, thus saving the expenditure of critical material in the drilling of additional wells that would normally have been necessary.

However, since the majority of the Cotton Valley wells were found to be productive of crude oil, the Natural Gas Division of the PAW, having jurisdiction, has refused to allow the crude oil to be produced, contending that critical material was expanded for the purpose of bringing into production natural gas only. The Oil and Gas Commission has established allowables for crude oil.

A major reserve of recoverable oil is believed present in the Cotton Valley formations and it is the contention of the operators and the state commission that it should be developed. A market and adequate transportation facilities are at hand to absorb the production as it is brought to the surface.

OKLAHOMA

THE SECONDARY-RECOVERY bill, which Governor Kerr has termed the most important bill to the war effort and to the economic future of Oklahoma which could be passed by the legislature, is still pending action by the oil and gas committee of the house. The committee will meet on call of the chairman to consider the bill.

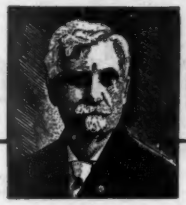
A bill providing for a secondary-recovery program for the Oklahoma City field developed into the hottest issue in the closing days of the last session of the legislature, and it is expected that the Batson bill, which would apply to all of the state except the Oklahoma City field, will assume a like interest this session.

COLORADO

THE BILL in the Colorado Legislature creating a power authority under which the state would own and operate public utilities and possibly engage in oil and gas exploration, has been sidetracked by reference back to a committee. The house, however, has authorized an interim committee to investigate the entire proposal and report back to the next legislature. The senate still has to act on the resolution. The ostensible purpose of the measure is for the state to purchase the properties of the Public Service Co. of Colorado.

the OIL AND GAS JOURNAL

PRODUCTION - TRANSPORTATION
REFINING - NATURAL GASOLINE



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PATRICK C. BOYLE

Regimentation in Refining

WHILE no definite statement of policy has ever been made by those in authority, it is evident that the government agencies are working more and more toward a program of unified operations for petroleum refiners in this country. The pattern for the whole, the implications of which the agencies themselves may not realize, is apparent by putting together the pieces that have become available during 16 months of war.

It behooves every refiner to study this program in relation to his own operations and to those of the entire refining industry. Refiners, operating between the needs of producers and the requirements of customers, have always been slow in asserting their rights and in stressing what is best for themselves and the remainder of the industry.

In this instance there is a very real threat that they will wake up 6 months or a year from now with a regimented control which will not serve the war and which will result in prolonged confusion after the war is over.

Under the Government's program plants making war products will continue to receive first consideration. That is as it should be, provided there is a clear understanding as to what these plants must have to maintain their war output.

These needs revolve principally around the rapidly expanding aviation-fuel and synthetic-rubber requirements followed by special lubricants, explosive ingredients, diesel fuels and other war products. The Government has said that these plants should also have first call on civilian demands. Then come the plants which are best located in regard to transportation.

This program involves wide variations in operating procedures, the emphasis being placed on the production of war-product hydrocarbons in some instances and on the enlarged output of the heavier products for civilians in other cases. To these processing changes should be added the shortages in materials, the dwindling sources of crude in some areas and the unsatisfactory manpower situation.

The Government's present answer to this is a pooling of operations in which part or all of A's crude may be taken from him and given to B; C will increase the yield of one product while D decreases his output of the same product and so on through the 412 operating plants. There are numerous involved problems to which the readily apparent answers are often not the sound answers.

If the war agencies insist on carrying out this program to the end it means further additions to the lists of shutdown refineries as reported in this Annual Refinery Number. Contrary to the expressed views of some at Washington these shutdowns and the drastic revisions in operating procedures are a responsibility of the Government and not of the petroleum industry.

Operators are entitled to compensation on a basis of what they do, whether they are making 100-octane gasoline or reducing the yields of their most valuable products in order to manufacture more of the lowest priced.

Refiners know what these war impacts mean better than anyone else. Through their own associations and through PIWC they have the opportunity of coordinating the facts and developing a working program which will adequately serve the emergency and preserve the oil industry's manufacturing activities as a free enterprise.

Productive Capacity of District 2 Falling, Future Estimates Lowered

by H. Stanley Norman

DOWNWARD revision of previous estimates on the productivity of oil states in the Mid-Continent and Middle West were made at Tulsa March 19 at regular meeting of PAW District 2 production committee, headed by O. D. Donnell, president of the Ohio Oil Co., Findlay, Ohio. Almost without exception, productive capacity of states in District 2 during subsequent quarters of this year and the first 3 months of 1944 were reduced at the insistence of committee members who compose a cross-section of operators in the area.

Don R. Knowlton, Washington, D. C., PAW director of production, attended and participated in discussions during the afternoon and night session of the committee.

Raymond B. Kelley, Illinois division manager for Pure Oil Co., was designated as technical adviser to the committee, to assist in its deliberations and to act as a representative of District 2 on a national technical committee. The technical production advisers from other districts, in addition to Mr. Kelley, will meet with the PIWC production committee at various times to consider technical problems on an industry-wide scale.

C. V. Millikan, petroleum engineer, Amerada Petroleum Corp., Tulsa, was designated alternate technical adviser to the committee. Carl Young, Dallas, Tex., secretary of the A.P.I. Production Division, will act as secretary of the national advisory group.

Price Question Bobs Up

The question of an adequate price for crude oil continually bobbed up during the committee's discussion of productive capacity. The price factor was given particular importance in several Mid-Continent states where older fields contain large volumes of oil recoverable by secondary-production methods. There was uniform opinion among committee members that very little can be expected from secondary-recovery operations until the price for crude is raised to permit expenditures such methods require.

The committee authorized a more detailed study of secondary-recovery potentialities to determine what, in the judgment of the producers themselves, might be expected in the way of increased production through such operations on the basis of a higher price for crude.

Another study was authorized by the District 2 group of the various fields to determine whether the production committee would be justified in recommending to PAW further exceptions to Conservation Order M-68 to provide closer spacing of wells, where it could be shown that such action would result in more efficient operation, increased production and at the same time a proper use of critical materials.

Recompletion Rules Studied

PAW, Mr. Knowlton told the District 2 committee, is working with a new provision that would simplify the regulations on recompletions, work overs, plug-back jobs and deeper drilling. He explained that the difficulty of maintaining equity between property owners was one of the most difficult problems encountered in considering some way that such work could be done without special exception from Washington.

Raymond B. Kelley, Illinois division manager for Pure Oil Co., was appointed technical adviser to the District 2 production committee and will serve with similar appointees from other districts on a national technical group

Since September, 1941, the committee was told, the production trend in District 2 has been almost continuously downward. From a peak of 1,200,000 bbl. daily in September, 1941, the productive capacity of the district has declined to a current rate of less than 1,000,000 bbl. daily. Crude oil stocks in January, 1941, were about 97,000,000 bbl., compared to approximately 59,000,000 bbl. in January, 1943, a decline of 38,000,000 bbl.

The trend in drilling operations and well completions, except for minor variations, was upward from January to October, 1941, and from then until March, 1942, it was sharply down.

Ralph Pryor, Wichita, Kans., independent, reported that the current production rate in some of Kansas' largest fields is excessive and that premature water encroachment is resulting from high withdrawals. He said that several Kansas operators are voluntarily petitioning the Corporation Commission to reduce allowables to a point where physical waste will not prevail and impair productive capacity.

Technical Organization Debated

Some of the most spirited discussion at the meeting developed over the proposal to establish technical committees in each of the districts which would have become according to plans, largely responsible for production policies. The general production committee turned down the proposal and the alternate of designating technical advisers in each district was adopted, leaving the final responsibility with the main group. Protests over the original proposal centered chiefly around the unwillingness of the main production committee to delegate its authority without also transferring responsibility.

H. N. Pardee, Tulsa, division manager of the Texas Co., was appointed chairman of the Oklahoma production subcommittee, succeeding L. F. McCollum, formerly president of the Carter Oil Co., who resigned because of his transfer to New York as vice president of several foreign producing subsidiaries of Standard Oil Co. (New Jersey). Mr. McCollum's place on the general committee will be filled by appointment by the Petroleum Administrator.

Federal Order Digest

OPA Rationing Orders

Gasoline—RO 5c, Amendment 31: Invalidates old-type acknowledgment-of-delivery forms used by the Army, Navy and other authorized agencies in lieu of gasoline-ration coupons; revised forms printed on safety paper similar to that used for gasoline coupons, effective March 20.

Gasoline—RO 5c, Amendment 32: Simplifies procedure for handling applications for obtaining gasoline rations for fleet and official vehicles, adds Washington and Oregon to the states in which restrictions on the amount of gasoline allowed for non-occupational boat use are to be applied, effective March 20.

Gasoline—RO 5c, Amendment 33: Incorporates more rigid car-sharing requirements in rationing regulations to promote more efficient use of public transportation facilities, tightens restrictions on private-passenger allotments, effective March 20.

Gasoline—RO 5c, Amendment 35: Qualifies virtually all types of installation, maintenance and repair service on essential nonportable goods for C rations, effective March 20.

Automobile Tires—RO 1a, Amendment 16: Liberalizes tires for all classes of drivers, particularly in the mileage-ration range of 240 to 560 miles per month, raises April quotas on all grades, effective April 1.

Farm Tires—RO 1a, Amendment 17: Specifies use of almost entirely reclaimed rubber for recapping farm tractor and implement tires, requires recapping all carcasses still serviceable, effective March 25.

Fuel Oil—RO 11, Amendment 50: Prohibits delivery of oil for electric generation in cases where power produced at existing coal or hydro plants can be made available, in the 17 eastern states, effective March 24.

OPA Price Orders

Petroleum—RPS 88, Amendment 82: Raises ceiling price on kerosene 0.3 cent per gallon in 17 eastern states and 0.25 cent at Gulf Coast refineries, effective March 17.

Petroleum—MPR 137, Amendment 28: Authorizes retailers to raise ceiling price on kerosene 0.3 cent at outlets in the 17 eastern states, setting specific ceilings at most East Coast distributing points, effective March 17.

Soaps—RPS 53, Amendment 25: Fixes dollars and cents maximum prices for certain raw and acidulated soap stocks at West Coast points, effective March 20.

WPB Limitations

Mud Additives—M-277, amended: Authorizes petroleum industry to use 150 per cent of 1941 consumption of quebracho or urunday extract (vegetable materials) for use as mud conditioners, issued March 15.

Natural Gas—SUO U-1-d: Provides advance approval of limited utility connections for construction or remodeling projects permitted under L-41, issued March 10.

Track-Laying Tractors — SLO L-53-b, Amended: Modifies controls on the distribution of repair parts for track-laying tractors, placing control over distribution at the producer level rather than at the dealer or distributor level, issued March 20.

Wrapping Paper—CO M-286: Prohibits nonessential uses of special papers used in wrapping, specifically glassine, greaseproof and vegetable parchment, effective March 17.

Transportation Orders

Passenger Vehicles — ODT 35: Freezes every vehicle carrying nine or more persons in local passenger transportation in present service, including all buses, street cars, trolley coaches, trucks converted for passenger use, ferry boats and other vessels, except combat equipment of the armed forces, effective March 17.

Pan American Reversed Line Moves Products

(Continued from Page 71)

Plantation system consists of 421.97 miles of 12-in. line from Baton Rouge to Atlanta, Ga., and 256.23 miles of 10-in. line from Atlanta to Greensboro, N. C. One hundred seventy-five miles of 8-in. line is now being laid to extend the system to Richmond, Va., completing a system through which products will be pumped 1,134.2 miles from the Texas City station to Richmond, Va.

In order to utilize its 12-in. line between Longview and Texas City for northbound products instead of southbound crude, it was necessary for Pan American to revamp its main line station manifolds and erect a terminal pump station at Texas City and a booster station at Henderson, Tex.

The Texas City station has a daily capacity of 34,000 bbl. of products. Four identical drilling-mud pumps were converted to products' service. The pumps are connected by "V" belts through a special firewall housing to four 220-hp. automotive-type gas engines. Second-hand material was used when available, to the end that the minimum amount of new, critical material would be expended in building the station.

The Henderson station has two 250-hp., three-stage, motor-driven centrifugal pumps capable of delivering 50,000 bbl. per day of products at 400 lb. pressure. The station building is of wood construction, covered with iron, and consists of a small office and pump room. All pumping equipment, valves, and fittings were second hand, thus saving a maximum of critical materials in the construction.

Redistribution Plan Soon To Be Applied To All Oil Supplies

WASHINGTON, D. C. — The Controlled Materials Plan goes into effect for the oil industry April 1, but PAW has not yet completed a draft of the new P-98-b which will give the industry access to materials under CMP. Prospects now are that the new P-98-b order will not be out prior to the deadline.

Probably within a week, PAW will issue Materials Redistribution Program 2, governing transfers within the industry of all used materials similarly to Program 1 which applies only to tubular goods. This will be mandatory after May 1 and will be made effective by a revision of P-98-c. After that date, no operator may obtain new materials until he participates in this program, and this will prevent obtaining new material if he has any surplus, defined as the amount normally needed for a 90-day period. The revised P-98-c will simplify and consolidate all controls over inventories and provide a system for the free flow of used materials within the industry and to foreign operations, replacing all former WPB and PAW inventory controls.

PAW March 22 announced an agreement with WPB for speeding up the administrative procedure in handling exceptions, appeals and denials under Conservation Orders M-68 and M-68-c and Limitation Orders L-56 and L-70 under which all papers will be issued over the signature of Deputy Administrator Davies, instead of the WPB program director.

Tide Water Contributes $26,000 to Red Cross

Tide Water Associated Oil Co., in a statement issued from its headquarters in San Francisco, Calif., today announced the contribution of $26,000 to the National War Fund campaign of the American Red Cross.

West Texas Crudes Still Shunned by War Refineries

by T. F. Smiley

HOUSTON, Tex.—West Texas producers, who had hoped for increased utilization of the sour crudes of that area in the manufacture of aviation gasoline, were disappointed Thursday, March 18, when a telegram from Ralph K. Davies, deputy petroleum administrator, was read at a state-wide proration hearing of the Texas Railroad Commission at the Rice Hotel, Houston.

"While this office recognized the desirability for an increased utilization of West Texas reserves and production, the transportation and refining facilities for handling the sour crudes from this area are definitely limited," wired Mr. Davies. "Until the transportation and refining problems are overcome we cannot jeopardize the maximum production of critical war products by currently increasing the use of West Texas crude."

Beauford Jester, chairman of the commission, announced that Harold L. Ickes, petroleum administrator, had advised the commission that daily production of 1,502,000 bbl. of petroleum liquids had been certified for Texas during April. This is the same as was certified for March. "The 50,000-bbl. daily increase as certified for March over February, and continued for April," added Mr. Ickes, "shall be allocated to sweet-crude oil fields other than the East Texas field, which are tributary to the War Emergency pipeline or the Houston-Beaumont refinery centers."

Mr. Jester urged that oil companies make every effort to utilize all types of crude, whether the sweet oils of the Texas Gulf Coast or the sour grades of West Texas, with a view to making the greatest possible contribution to the war effort. Gulf Coast crudes, said the commission chairman, have no superior in the production of high-test aviation gasoline. He declared it to be his belief, however, that the sour crudes of West Texas would make just as high-grade fuel for aviation purposes.

J. S. Leach, vice president of Texas Co., told the commission that his company's April nominations for West Texas crude were based on the 50 per cent pipe-line proration placed on March allowables. Texas Co., he said, was willing to yield any connections in West Texas. On account of inadequate transportation facilities, he added, the company had been compelled to impose a 15 per cent pipeline proration on allowables in the Pickett Ridge, Markham, West Columbia and other Gulf Coast fields.

Rex G. Baker, attorney for Humble Oil & Refining Co., informed the commission that Gulf Coast fields in which Humble operates are producing 216,918 bbl. daily whereas they could produce 347,000 bbl. without waste. The company's nominations for Gulf Coast crude were advanced 2,000 bbl. daily to 112,360 bbl. Outlet for Southwest Texas oil will be increased 1,000,000 bbl. in April, Mr. Baker said, and nominations were raised to provide for this higher requirement.

Increased allowables were asked by Mr. Baker for Humble, in the Hawkins pool, Wood County; by H. S. Lane for Crown Central Petroleum Corp., in the Hastings pool, Brazoria County; by Maston Nixon, for Southern Minerals Corp., in the Saxet pool, Nueces County, and by Martin Rowe, for Sun Oil Co., in 13 Southwest Texas pools.

Commenting on an announced drop of 4.41 lb. in the bottom-hole pressure of the East Texas field, Paul McDermott, representing Sinclair Prairie Oil Co., said the 1,016.14 lb at which the pressure stood on March 1 was satisfactory and he asked that the field be allowed to produce 22 days in April, instead of 20 as in March. Sinclair Prairie was granted an increase of 1,000 bbl. daily in the Flour Bluff and East Flour Bluff pools.

E. H. Foster, of Amarillo, speaking for Phillips Petroleum Co., urged that the producing days in the Panhandle be increased from 24 to 26.

Louis Sauer, of Republic Production Co., asked that the shutdown days in the Midway, Heyser, and East White Point pools be discontinued.

Joe Hill, former state senator, said Southport Petroleum Co., which he represented, was having trouble in getting the type of crude needed for the 100-octane gasoline unit which the company was installing and that the company's nominations were being increased 15,000 bbl. daily.

Chairman Jester said the Petroleum Administration had been asked to designate the quantity and grades of oil required for the war effort and to permit the commission to allocate production among fields capable of producing the oil without waste.

Production Quota Reduced

WASHINGTON, D. C.—A net decrease of 7,700 bbl., in the daily average certified production quotas for April is provided in the Petroleum Administration's schedule released last week, calling for output next month of 4,186,100 bbl. per day.

The rates of production certified to the eastern and midwestern states, PAW District 1 and 2, were generally reduced to conform with the continued declining productive capacity in those areas.

Major declines in District 2 were in Oklahoma, off 11,400 bbl. daily and Illinois, cut 10,400 bbl.

Upward revisions in Districts 3 and 4, consistent with increased demand for Louisiana crude and the necessary seasonal adjustment for the Rocky Mountain states, partially offset decreases in Districts 1 and 2.

Production rates for Texas and California remained the same as the March certifications.

The certified rate of production in April is 475,700 bbl. per day greater than the actual production of all petroleum liquids for the same month last year.

Certified Production Rates, Total Petroleum Liquids
(Barrels Per Day)

	April 1943	Mar. 1943
District 1:		
New York	15,000	15,400
Pennsylvania	50,700	50,700
West Virginia	18,900	19,400
Total	84,600	85,500
District 2:		
Illinois	251,900	262,300
Indiana	16,000	16,500
Kansas	309,900	309,900
Kentucky	20,000	19,400
Michigan	63,700	63,700
Nebraska	2,600	2,800
Ohio	9,700	10,100
Oklahoma	379,300	390,700
Total	1,053,100	1,075,400
District 3:		
Arkansas	78,600	78,700
Louisiana	359,300	349,800
Mississippi	50,000	50,000
New Mexico	105,700	105,600
Texas	1,502,000	1,502,000
Total	2,095,600	2,086,300
District 4:		
Colorado	7,400	7,000
Montana	24,600	23,400
Wyoming	97,100	92,500
Total	129,100	122,900
District 5:		
California	823,700	823,700
Total United States	4,186,100	4,193,800

Petroleum Research Paid High Tribute at Bayway Ceremony

BAYWAY, N. J.—The least known but an important part of industry in the war program—research—was recognized here last week when the Army-Navy "E" award was presented to the Standard Oil Development Co. The presentation was made by Brig. Gen. A. H. Waitt and the flag was accepted by R. P. Russell, executive vice president. General Waitt listed as "outstanding contributions to democracy's cause" several products of the company which are far removed from those normally associated with oil research.

Products which he mentioned included "the Essosmoke generator which is invaluable for camouflaging vital installations. It is already in active service overseas besides being on guard in our own country. You redesigned this generator so that it could be made from available material. Your staff also developed suitable oils.

"You did much the same sort of revolutionary job on the portable flame thrower. The results of your experiments with a certain type of incendiary have been outstanding in their ingenuity and performance. Also you filled incendiary bombs by the thousands in order to learn the best technique for carrying on loading operations."

Frank A. Howard, president of the company, presided at the services which marked the second time only that the Army-Navy "E" has been awarded in the field of research generally and the first time in the field of petroleum research. In his remarks opening the ceremonies Mr. Howard said:

"In addition to its normal function in the oil industry, this organization has had to fight four major technical development campaigns for the nation: (1) It had to find how to make enormous increases in the output of 100-octane gasoline, a problem which looked so difficult that the French dismissed it as a technical impossibility in making their own war plans. (2) It had to break the bottleneck in explosives production by developing a process for turning out unlimited quantities of toluene from petroleum. (3) It had to build a new synthetic rubber industry, based mainly on petroleum. (4) It had to become an emergency technical arm for the Army and Navy. Of these last activities we may mention at this time only the general subject of petroleum warfare."

Mr. Russell, in accepting the award, cited the past record of the company which "not only includes the petroleum warfare devices worked out cooperatively with the Chemical Warfare Service but also includes development of the process being used for making most of the toluene going into TNT in the United Nations' shells of high-explosive bombs. Further, it includes a large share of the pioneer work on 100-octane aviation gasoline processes which as used in the refineries of the Standard Oil Co. (New Jersey) group alone accounts for more than 1 out of every 5 gal. used by our air forces and, which, when the present government 100-octane program is completed, will be used to make more than half of the supplies of this vital fuel."

Presentation of the "E" pin was made by Comdr. A. S. Kibbee of the U. S. Naval Reserve. The acceptance was made by E. G. Kinsman, of the process division, as a representative of the more than 1,500 employes of the research organization. Mr. Kinsman was introduced as one who had put in 1,300 hours of overtime work in the Jersey laboratories since Pearl Harbor. Mr. Kinsman pledged "a continuation of the research and development and experiment that resulted in achievements sufficiently outstanding to merit the recognition of our Government."

Among those participating in the ceremony were, left to right: Brig. Gen. A. H. Waitt, U. S. Army; R. P. Russell, executive vice president; E. G. Kinsman who represented the employes; P. S. Makeev, chief, Russian rubber commission; Frank A. Howard, president; Douglas H. McLean, New Jersey congressman; Rear Adm. S. R. Dight, C. B. E. British Navy; L. A. Razin, member Soviet Government Purchasing Commission, and Comdr. A. S. Kibbee, of the U. S. Naval Reserve.

Ten Engineering Sessions At National Aircraft Meet

Igor I. Sikorsky, famed designer of aircraft, is one of the many speakers to address the National Aeronautic meeting to be held in Hotel New Yorker April 8 and 9, New York City, Society of Automotive and Aeronautical Engineers headquarters announces. The sessions during this two-day meet, the most important held during the year by aircraft engineers will be divided mainly between aircraft design problems and aircraft engine design and testing.

On Thursday papers of major interest to oil men and refiners will be those on the Chevrolet aviation engine test plant and its operation; training operators for testing aviation engines. On Friday the effect of temperatures and stresses on aluminum pistons, and new types of bearings will be the main subjects before the aircraft-engine sessions. On Friday evening Mr. Sikorsky will address the meeting and receive the Wright Brothers medal presented by S.A.E. president Mac Short, Vega Airplane Co., Burbank, Calif.

Stanolind Purchases Shasta Oil Properties

MIDLAND, Tex.—Stanolind Oil & Gas Co. has purchased all of the Clifford Mooers interests' oil leases, both producing and nonproducing. The properties, formerly operated in the name of Shasta Oil Co., are located in West Texas, East Texas, South Texas, Lea County, New Mexico, and Cotton County, Oklahoma.

Offices of the Mooers interests here will remain open to handle royalties, none of which was involved in the sale. Included in the sale was the Shasta Pipe Line Co. which has 10 miles of line in Pecos County, Texas. The deal is said to have involved a transaction of more than three-quarters of a million dollars.

Rationing Forces Gasoline Use Down 32.8 Per Cent

DOMESTIC gasoline consumption declined 32.8 per cent during the first full month of national rationing, according to figures released last week by the American Petroleum Institute comparing December 1942 gallonage with the same month a year earlier. Domestic consumption for all of 1942, the A.P.I. reported, totaled 22,373,427,000 gal. (532,701,000 bbl.), a decline of 12.56 per cent.

The figures, explains the A.P.I., are based on returns made in accordance with the various state gasoline-tax and inspection laws and reflect as nearly as possible the total consumption of gasoline, whether taxable, subject to refund or not. The element of difference between A.P.I. monthly figures and the domestic demand calculated by the Bureau of Mines customarily ranges between 2 and 3 per cent and by crediting this allowance to the state totals they can be compared with previous bureau reports.

Higher Exports Reflected

Apparently, however, taxable gallonage last year fell off more abruptly than total gallonage inasmuch as preliminary Bureau of Mines figures indicate that total demand, including domestic, export and military, in 1942, declined only 9 per cent. The Bureau of Mines indicated a decline of 25 per cent in all demand in December. More moderate declines in total gasoline demands, compared with domestic consumption, probably reflects higher exports. Also, observers pointed out, the factor of difference between A.P.I. and Bureau of Mines' figures may have have broadened by various elements in military consumption.

The most severe declines reported in December were in Oklahoma, off 53.5 per cent; Louisiana, 52.4 per cent and Illinois, down 52.1 per cent. Of almost equal magnitude were declines of 46.4 per cent in Missouri, 42.1 per cent in New Hampshire, 41.6 per cent in Vermont, 41.4 per cent in Kansas, 41 per cent in Alabama and 40 per cent in Virginia.

California consumption in December was only 0.6 per cent less than a year earlier despite the imposition of rationing and probably reflects the extent of expanded military and war-industry operations. A comparatively mild decline of 3.7 per cent is reported in Utah while Nevada lost 10.5 per cent.

Tax figures on gallonage in December, statisticians say, may not be truly indicative of consumption because of the fact that practically every passenger car in the country outside the East Coast area, ended November with filled gasoline tanks. Consequently, actual consumption by two-thirds of the automobiles in the country may have run from 5 to 10 gal. per vehicle more than reflected by the tax figures. However, it may be assumed that most motorists acquired in December virtually all of the gasoline permitted by rationing regulations and therefore the tax returns may be truly indicative of the retrogression resulting from mileage restrictions.

GASOLINE CONSUMPTION BY STATES, DECEMBER 1942

(Thousands of gallons)

	Dec. 1942	Dec. 1941	Per cent decline
Alabama	16,857	28,564	41.0
Arizona	8,992	12,492	28.0
Arkansas	13,894	21,262	34.6
California	200,524	201,760	0.6
Colorado*	.....	.....	...
Connecticut	23,151	36,074	35.8
Delaware	3,553	5,667	37.3
Dist. of Columbia	10,263	17,044	39.8
Florida	36,119	44,815	19.4
Georgia	25,394	40,221	36.9
Idaho	5,492	8,490	35.3
Illinois	63,747	133,209	52.1
Indiana	40,766	67,038	29.2
Iowa	29,258	47,605	38.5
Kansas	23,453	39,999	41.4
Kentucky	17,600	28,372	38.0
Louisiana	13,415	28,194	52.4
Maine	8,723	12,996	32.9
Maryland	22,805	32,263	29.3
Massachusetts	43,389	67,206	35.4
Michigan*	.....	.....	...
Minnesota	32,472	46,305	29.9
Mississippi	20,041	23,326	14.1
Missouri	35,171	65,649	46.4
Montana	6,947	9,738	28.7
Nebraska	13,266	18,999	30.2
Nevada	3,530	3,945	10.5
New Hampshire	4,532	7,832	42.1
New Jersey	56,618	84,951	33.2
New Mexico	6,792	9,380	27.6
New York	110,951	165,063	32.8
North Carolina	30,078	48,308	37.7
North Dakota	7,317	10,389	29.6
Ohio	88,917	140,136	36.3
Oklahoma	20,315	43,719	53.5
Oregon	16,373	24,699	33.7
Pennsylvania	86,864	144,146	39.7
Rhode Island	9,873	11,906	17.1
South Carolina	15,250	23,924	36.3
South Dakota	9,601	11,151	13.9
Tennessee	26,808	39,964	32.9
Texas	96,671	135,690	27.3
Utah	8,578	8,903	3.7
Vermont	3,293	5,639	41.6
Virginia	26,461	44,116	40.0
Washington	26,672	38,697	31.1
West Virginia	13,965	20,160	30.7
Wisconsin	31,243	49,214	36.5
Wyoming	3,389	5,571	39.2
Total	1,421,383	2,114,791	32.8
Daily average	45,851	68,219	

*Not available at time of publication.

Operators May Uprate Certain Supply Orders

WASHINGTON, D. C.—F. A. Watts, director of materials, Petroleum Administration for War, last week advised that it is permissible for operators in the petroleum industry, on any purchase orders already placed by them to which preference ratings have been properly assigned in accordance with the terms of P-98-b, as amended January 29, 1943, or on form PD-1A, to uprate orders to an AA-1, providing that the material covered is for maintenance, repair and operating supplies and that delivery of such material will be later than March 31.

Such uprating may be given to the suppliers by means of a letter or corrected or supplemental purchase order or contract and no certification other than the applicable CMP Regulation 5 certification need be given. The certification which is quoted in CMP Regulation 7 can be substituted for either of the certifications quoted in CMP Regulation 5. If the material covered by the purchase order is to be used for maintenance, repair or operating supplies, this should be indicated on the the purchase order.

Such uprating letter, corrected or supplemental order need not be countersigned by the district director of materials because of the fact that it is assumed that the essentiality was established when the order was originally placed.

Carter Chief Scout Made Assistant to President

R. B. Curran, formerly chief scout and head of the scouting and statistics division of Carter Oil Co., has been named assistant to the president, O. C. Schorp. R. D. Sloan will assume charge of the scouting and statistics division, in addition to his present assignment as chief statistician. Wayne W. Breedlove is being transferred from Mattoon, Ill., to Tulsa as chief scout. All changes are effective immediately.

Mr. Curran was employed by Carter in the geological division in 1933. He transferred to scouting in 1935 and in 1938 was moved from Seminole to Tulsa as chief scout and assistant to Tom Brownfield, then manager of the scouting and statistics division. He became head of the division when Mr. Brownfield joined the Standard Oil Co. (New Jersey) organization in New York in September 1941.

Mr. Sloan, a graduate geological engineer, engaged in surface work for Carter in eastern Colorado and south-

ern Oklahoma in 1934. He was transferred to subsurface work in Kansas in the same year, and in 1937 became district geologist in Illinois. In 1939 he was moved to Tulsa and organized Carter crude-oil reserve section, and in September 1941 he was made chief statistician.

Mr. Breedlove, who for the past several years has been eastern division chief scout with headquarters at Mattoon, has been employed by Carter in the scouting division since 1925, spending 13 years of that time in the Tulsa office. He was transferred to Mattoon in 1938.

Kerosene Ceiling Raised At Gulf and Eastern Points

WASHINGTON, D. C.—To restore the normal differential between kerosene and domestic fuel oil, the Office of Price Administration March 17 raised maximum prices on kerosene by 0.3 cent per gallon in the 17 eastern states and the District of Columbia, and 0.25 cent at Gulf Coast refineries.

The raise was made with the approval of the Petroleum Administrator for War and became effective March 17.

The maximum price increase 0.25 cent at Gulf Coast refineries and 0.3 cent at eastern refineries is passed on to all intermediate venders and to the ultimate consumer.

Tulsa S.A.E. to Discuss Lubricants, Planes

A two-session meeting of the Mid-Continent S.A.E. section at Tulsa's Mayo Hotel Friday afternoon and evening, March 26, will be the largest of the regular meetings of that section in its 7-year history. Friday afternoon, the problems arising from new specifications and requirements for aircraft and other military lubricating oils will be discussed in a mainly off-the-record meeting led by B. E. Sibley, chief technologist for Continental Oil Co. He will present the new requirements in lubricants and the problems faced by manufacturers of those oils, a discussion of primary interest to refiners.

Friday evening "Aircraft in the Making" will be the subject of a 2-hour presentation of three films made by the Navy Department showing present methods for mass production of planes, presented by Lt. F. J. Kelly, Naval Bureau of Aeronautics, and Lt. Comdr. W. E. Garrity, U. S. Navy, formerly of the Walt Disney Studios, Hollywood. Commander Garrity supervised the sound effects on these films which were made in the Disney Studios and in five aircraft factories in the United States. Animated cartoon methods are employed to illustrate many procedures which cannot be shown satisfactorily by the camera. The evening meeting has been thrown open to refining, aircraft and other engineers in Oklahoma.

N.P.A. Trustees to Meet

WASHINGTON, D. C.—Trustees of the National Petroleum Association will meet at the Cleveland Hotel, Cleveland, on April 15 and 16. Each member company of the association has been asked to have one representative present. This will reduce the attendance but make possible important round-table discussions.

Daily Eastern Deliveries May Reach 1,730,000 Bbl.

WASHINGTON, D. C. — Daily deliveries of 1,730,000 bbl of petroleum to the East Coast by the end of this year are in prospect with definite assurance that the minimum will not be less than 1,600,000 bbl. This projection of results from alternate transportation arrangements made and being prosecuted by private companies and government agencies was made last week by the Petroleum Industry War Council's transportation committee, headed by W. Alton Jones, president of Cities Service Co.

"The revolution in petroleum transportation to supply the East Coast virtually will be completed by next fall, but rapidly increasing military demands undoubtedly will prevent the use of the much larger deliveries for any substantial increase in non-essential civilian consumption," explained William R. Boyd, Jr., chairman of PIWC, in releasing a chart showing the petroleum deliveries into this area in 1941, 1942 and the forecast for this year.

Short of Prewar Levels

"The chart reveals," he said, "that we have not yet been able to reach prewar levels by substitute methods of transportation. For the last few months, shipments have averaged only about 1,100,000 bbl daily.

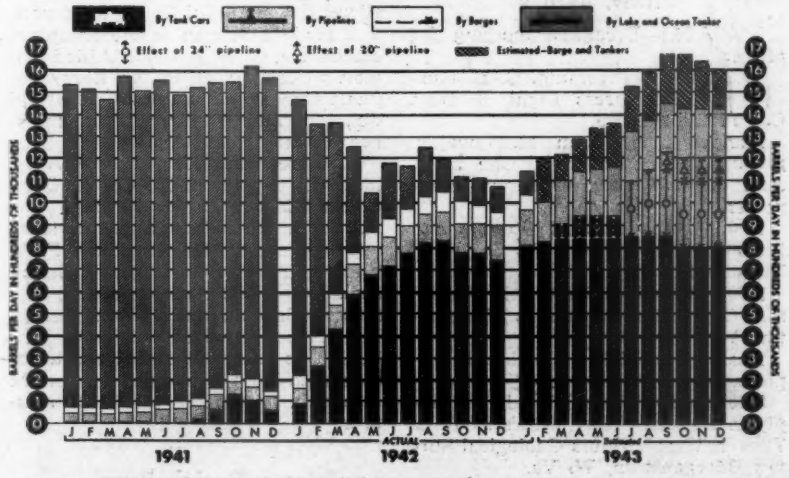
"By the end of 1943, however, deliveries should actually be greater than they were before the war. Unfortunately, the civilian consumer may not get any part of these increased deliveries and some degree of rationing will continue. In fact, the present forecasts of military demands indicate a definite possibility that the shortage next winter will be equally as critical as it was this winter."

Here is the way the PIWC breaks down its East Coast delivery forecast for the end of 1943:

Delivery method	Bbl. daily
Pipe lines	*730,000
Tank cars	800,000
Barges and tankers	200,000
Total	1,730,000

*Includes 130,000 bbl., dependent on completion of the 20-in. products line all the way to the East Coast.

DELIVERIES OF PETROLEUM INTO DISTRICT No. 1


By Tank Cars
By Pipelines
By Barges
By Lake and Ocean Tanker
Effect of 24" pipeline
Effect of 20" pipeline
Estimated—Barge and Tankers
BARRELS PER DAY IN HUNDREDS OF THOUSANDS
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
ACTUAL
ESTIMATED
1941
1942
1943

Deliveries to District I in 1941 were, in general, representative of pre-emergency conditions. Deliveries in 1942 show the transition from use of tankers to substitute means of transportation. Estimated increased deliveries in 1943 reflect the effect of completion of the 24-in. line to Philadelphia and New York and the first section of the 20-in. line from the Gulf to Seymour, Ind. These estimated increased deliveries will be required to meet a greatly expanded military demand for petroleum and to supply civilian markets on rationed bases.

Emergency Regulations Feature A.P.I. Program

PITTSBURGH, Pa. — Emergency regulations on drilling and on materials will share the spotlight with economic and operating problems on the program of the Eastern District, A.P.I. Division of Production which will hold its spring meeting here April 8 and 9.

A feature of the meeting will be the address of Gov. Edward Martin of Pennsylvania at the annual dinner Thursday night, April 8.

The Preliminary Program
Thursday, April 8

8:00 A.M.:—Breakfast meeting for officers of the Eastern District, presiding officers, authors and discussers. Forum Room.

8:30 A.M.: — Registration — Silver Room.

10:00 A.M.:—Presiding: M. G. Gulley, Gulf Oil Corp., Pittsburgh, Pa. Address of Welcome, Cornelius D. Scully, mayor of Pittsburgh.

10:15 A.M.:—Response by Mr. Gulley, chairman of the Eastern District.

10:25 A.M.:—The Business of War by Ralph T. Zook, president, Sloan and Zook Co., Bradford, Pa.

2:00 P.M.: — Presiding: Virgil F. Bowyer, Peoples Natural Gas Co., Pittsburgh, Pa.

Government Regulations on Drilling by Justin Wolf, PAW attorney.

2:45 P.M.: — Controlled Materials Plan by representative of PAW Materials Division.

3:30 P.M.:—Four 15-minute talks on material conservation practices.

7:00 P.M.:—"Victory Dinner"—Edward Martin, governor of Pennsylvania will deliver an address, followed by entertainment.

Friday, April 9

8:00 A.M.:—Breakfast meeting for officers.

10:00 A.M.:—Presiding: C. B. Mershon, Manufacturers Light & Heat Co., Pittsburgh, Pa.

Manpower by John M. Lovejoy, president of Seaboard Oil Co., chairman of PIWC committee on manpower.

11:00 A.M.:—Synthetic Rubber and the Petroleum Industry by Dr. F. H. Dotterweich.

2:00 P.M.:—Presiding: R. B. Anderson, Columbian Carbon Co., Charleston, W. Va.

Business session and chapter reports.

2:30 P.M.:—Future Oil and Gas Supply in Eastern United States by R. C. Tucker, West Virginia Geological Survey, Morgantown, W. Va.

3:00 P.M.:—Natural Gas Situation in Industrial East by H. J. Wagner, chief, gas section, West Virginia Public Service Commission, Charleston, W. Va.

3:45 P.M.:—Standby Fuel Services in Industrial Plants by Dr. Rolla Miller, Peoples Natural Gas Co., and Carl V. Spangler, J. F. Pritchard Co., Pittsburgh, Pa.

B. E. Gray Made Manager of Asphalt Institute

NEW YORK.—Bernard E. Gray, a member of the Asphalt Institute staff for 13 years, was promoted to the position of general manager, adding the duties of that office to those already held as chief engineer, at the annual meeting of the board last week. Mr. Gray has served the institute successfully as highway engineer, chief highway engineer and chief engineer.

BERNARD E. GRAY

Herbert Spencer was reelected president for the ensuing fiscal year. J. A. Blood, Standard Oil Co. of California, was made chairman of the executive committee; C. W. Barbour, Allied Materials Corp.; H. B. Pullar, Berry Asphalt Co.; David Waxman, Shell Oil Co., Inc., and Mr. Spencer are members of the committee.

Vice presidents elected were: A. M. Maxwell, Standard Oil Co. of Ohio; Glenn Nielson, Husky Refining Co.; H. G. Nevitt, White Eagle division, Socony-Vacuum Oil Co., Inc.; F. V. Widger, Texas Co.; Roger Williams, Standard Oil Co. of Louisiana; and Messrs. Barbour and Pullar. George R. Christie, Standard Oil Co. of New York, was elected secretary and treasurer with John N. Smith, of the same company, was made assistant treasurer.

Louisiana Parish Bars Highway Geophysical Work

ABBEVILLE, La. — Geophysical work along highways is prohibited by a resolution adopted last week by the Vermilion Parish, Louisiana, police jury. The jurors declared it was unfair to property owners for oil companies to use the highways for geophysical work and thus determine the potential value of abutting land for oil production. Formerly oil companies were allowed to make seismograph and other geophysical surveys with the permission of abutting landowners.

DEATHS

Woodrow Gold, 29, an employe of Canadian River Gas Co., Amarillo, Tex., died in an Amarillo hospital last week. His widow and a daughter survive.

John Shopene, 76, retired employe of South Penn Oil Co., died in Titusville, Pa., last week. He had lived in Titusville for the past 20 years. He is survived by three sons.

T. J. Moore, son of pioneer Texans, and an oil man for 30 years, died in a hospital in Dallas, Tex., last week. His widow and two sons survive.

Benjamin J. Skinner, 65, president of Midwest Refineries, Inc., Grand Rapids, Mich., died of a heart attack at his home in Grand Rapids early this week.

John Neal Peterson, 54, East Texas oil man and philanthropist, died at Kilgore last week after an illness of several months. His widow survives.

E. Calvin Beatty, 83, retired oil operator of Oil City, Pa., died in an Oil City hospital last week, following an illness of several months. Three sons and three daughters survive.

Harry D. Davis, Oklahoma City, Okla., oil broker, died last week in an Amarillo, Tex., hospital. His widow and a daughter survive.

W. A. Moores, formerly pilot for Texas Co. in South Louisiana, was killed last week at the Jackson, Miss., air base, when he attempted to bail out of his training ship at the Royal Dutch Air Training School, where he was a first lieutenant. His widow and a daughter survive.

Bert Lochead, 62, a resident of Tulsa for more than 30 years, died at Ferguson, Mo., last week. A former employe of Mid-Continent Petroleum Corp., for whom he had worked for 20 years, he had been retired for the past 10 years. He is survived by his widow.

Ralph O. Gooding, 62, for 28 years assistant manager of sales for the Allis-Chalmers, Norwood, Ohio, works, died March 3. His supervision of motor and generator sales was especially directed to the petroleum industry for many years.

WAR TIME
REFINING

War Needs Bring Many Changes in Processing

by C. R. Wagner

One of the recently installed plants making isooctane for aviation superfuels

THE two subjects claiming most attention during the past year and today are aviation gasoline and synthetic rubber. The early practice of announcing the goal for aviation-gasoline production was discontinued about the time that the man on the street began to wonder how much was 150,000 bbl. per day. What is present production and what is the present goal are questions that may be answered after the war. The thinking petroleum refiner is impressed, however, by a forecast production of 100-octane motor fuel which equals or exceeds the previous production of Ethyl gasoline. The effect of such a situation in the postwar period upon transportation is certain to be profound.

Aviation gasoline usually consists of four products: (1) a blending agent, such as alkylate, isooctane, hydrocodimer, neohexane, etc.; (2) a base stock, such as high-octane straightrun gasoline or selected cuts from straightrun gasoline, a special cut from the catalytic treating of gasoline from catalytic cracking, alkylated aromatics, etc.; (3) isopentane to secure desired volatility; and (4) tetraethyl lead. Production of the first two products has led to the development of new processes, and in some cases, new products of improved characteristics. Developments in this field are continuing at an accelerated rate, and we may confidently expect startling improvements in the synthesis of ingredients for aviation gasoline, although the public may hear little of them until the war is over.

Although noncatalytic and sulfuric acid alkylation processes had been in use for 2 or 3 years before 1942, the year saw a tremendous development in the use of hydrofluoric acid alkylation. The first plant using this catalyst was placed in operation by Phillips Petroleum Co. in December, 1942. The obvious advantages of the process are: (1) the catalyst is regenerated within the plant and disposal of spent acid is therefore no problem; (2) since the reaction proceeds satisfactorily at temperatures as high as 130° F. no refrigeration is required; (3) investment costs are lower because of 1 and 2.

C. R. Wagner, one of the foremost authorities on refining technology and petroleum chemistry, here reviews briefly and under the handicap of obviously necessary secrecy and censorship regulations the more important process developments which the refiner now has with which to attack the serious problems of aviation fuels and lubricants, synthetic rubber and other products all important to our wartime economy. These processes comprise the more important refining technology of the present and future and usher refining into advanced progress era.

Mr. Wagner is eminently fitted to discuss these subjects, having been for several years head of the manufacturing committee of Pure Oil Co., and chief of the Process Development Section, Refining Division, Office of Petroleum Administrator for War.

A simplified flow sheet of the process is shown in Fig. 1. The dry fresh feed mixed with recycle isobutane and acid is introduced into a contactor where vigorous agitation is applied for the desired length of time. The reactor effluent is then separated, the acid being recycled, and the hydrocarbon passes to a unit to recover HF dissolved in the hydrocarbon The hydrocarbon stream is then fractionated to recover isobutane for recycle, the normal butane is removed, and the alkylate rerun to produce the desired boiling range product for making aviation gasoline.

HF, New Catalyst

Although hydrofluoric acid costs more per pound than sulfuric acid, it requires less investment in manufacturing plants to produce the acid, and the investment in acid-recovery equipment is also much less. As a result over-all catalyst costs for the HF process will probably be no more, and very possibly considerably less, than the catalyst cost in the sulfuric acid process. The lesser quantity of construction materials needed in the

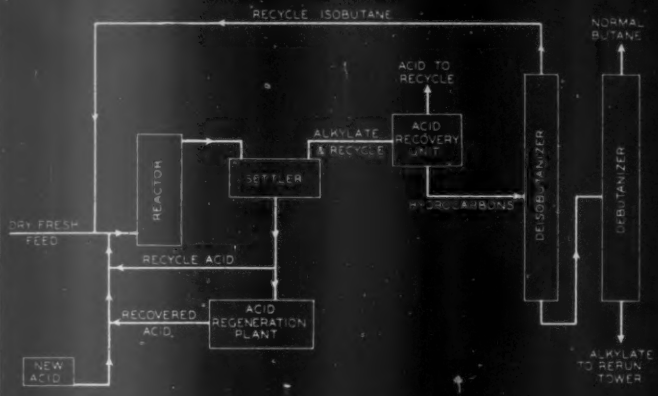


FIG. 1—HF ALKYLATION PROCESS

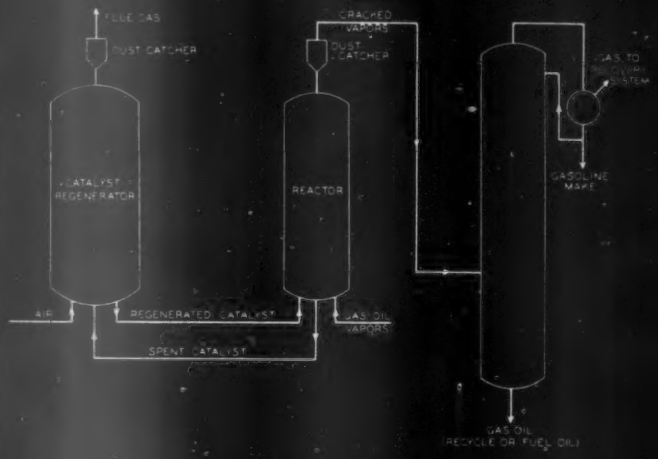


FIG. 2—FLUID CATALYTIC-CRACKING PROCESS

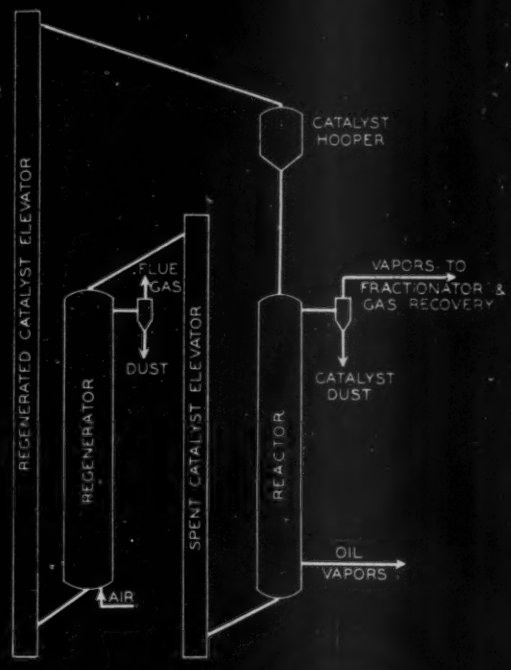


FIG. 3—THERMOFOR CATALYTIC CRACKING PROCESS (T. C. C.)

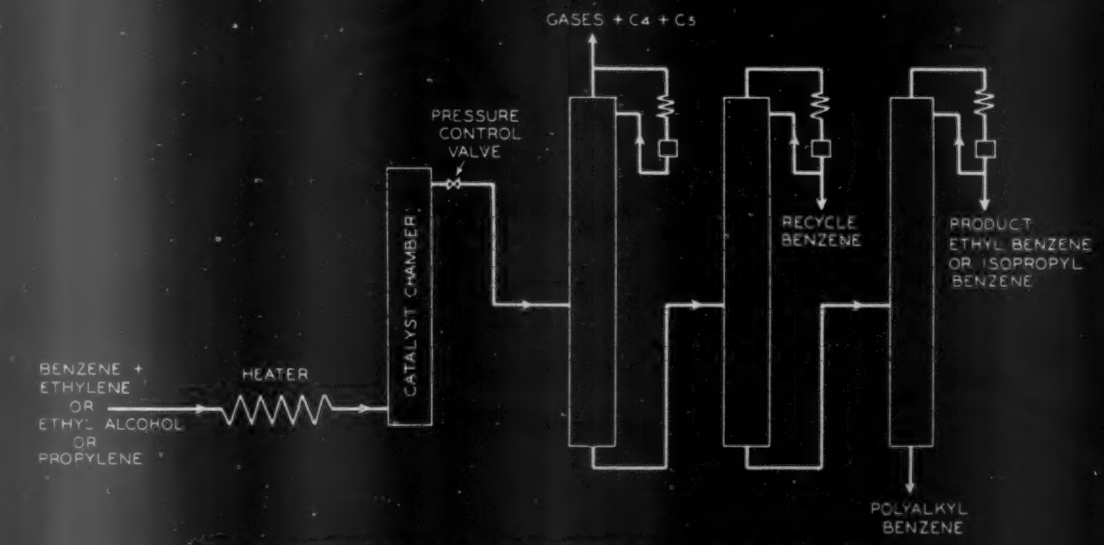


FIG. 4—PROCESS FOR ALKYLATION OF AROMATICS

HF process, therefore, makes it particularly attractive at this time.

Precautions must be exercised in the handling of HF, as in the case of strong acid of any kind, but the hazards are considerably less than the chemistry textbooks would indicate. Burns by HF are difficult to heal, but so are those produced by H_2SO_4 or HNO_3. The anhydrous acid can be safely handled in ordinary steel equipment, and the most serious trouble to be expected is that encountered by dilution with water.

The operation of the processes installed and under construction to produce blending agents will require huge supplies of C_4 olefins. In some cases these stocks can be supplemented by C_3 olefins, and by propylene. The alkylate produced from these olefins is somewhat poorer in quality, and in the case of propylene will require more isobutane per gallon of alkylate than will C_4 olefins. So far no plants have been constructed for the alkylation of isobutane with ethylene except the neohexane plant of Phillips Petroleum Co., built about 3 years ago.

In the field of catalytic cracking, Houdry process units have been operated to produce aviation base stock. Standard Oil Co. of New Jersey announced during the year the operation of their first fluid catalyst unit in Louisiana and more recently a second unit at Bayway, N. J. A simplified flow sheet of the unit is shown in Fig. 2.

Gas oil or naphtha vapors are introduced continuously into the reactor with the desired amount of regenerated, hot catalyst. The temperature of the catalyst is regulated by the amount of carbon allowed to accumulate on the spent catalyst. The heat generated by burning this carbon is retained by the catalyst (except for that carried away by the flue gases generated) and serves to supply the endothermic heat of reaction. Cottrell precipitators are employed to recover fine catalyst dust carried away by the flue gas stream. In both reactor and regenerator the finely divided catalyst is moved through the system by a stream of gas; in the one by oil vapors, in the other by air and flue gases.

Catalytic Cracking Increases

Characteristics of the products of the fluid catalyst process are similar to those produced by the Houdry or Thermofor processes. Quality of the gasoline produced is influenced by the character of the catalyst and by the time and temperature employed in contacting the vapors with the catalyst. In general the higher the temperature the more aromatic the character of the gasoline produced. Increasing the time of contact affects the results similarly. By proper selection of catalysts, the olefin and isoparaffin content of the gasoline may be varied quite widely. As explained by Bates and Rose (I.E.C. 34, 147-152-Feb., 1942) the proportions of isoparaffins and n-paraffins are the result of failure to reach thermodynamic equilibrium. The catalyst enables the production of gasoline at a low enough temperature that equilibrium is not reached in the time given. This gives a preponderance of isoparaffins over paraffins.

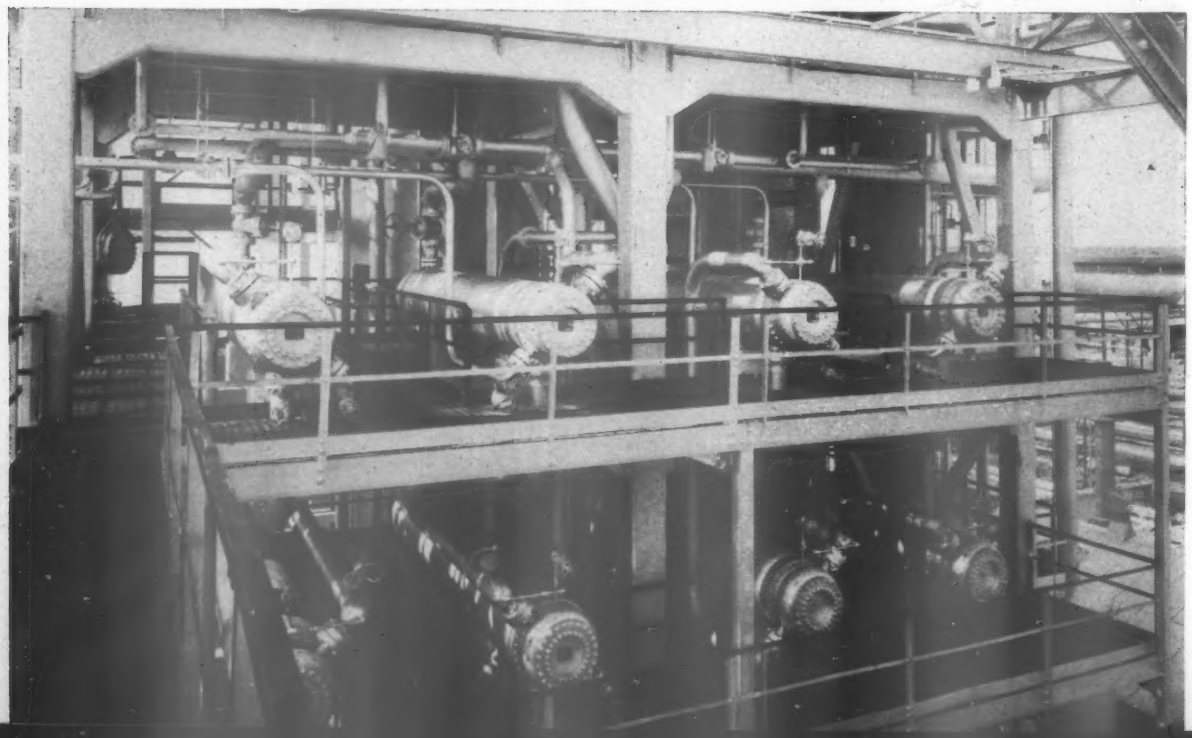
Where isoparaffins are produced in lesser quantities, olefins are usually found in larger amounts, and the ratio of aromatics to olefins in catalytically produced gasoline is higher than that for gasoline produced in high-temperature noncatalytic processes. The presence of these alkyl aromatics has a pronounced effect upon the octane number of the gasoline produced. By use of special catalysts the fluid-catalyst process, as well as the other catalytic-cracking processes, may be used to treat gasoline produced by inferior (or cheaper) catalysts, or gasoline produced by reforming or thermal cracking processes, in order to make a suitable aviation base stock.

The Thermofor catalytic cracking (TCC) process is diagramatically illustrated in Fig. 3. In this unit the catalyst is moved by mechanical conveyors instead of by air or vapor streams, and the catalyst particles are much larger than in the fluid catalyst process. The catalyst moves countercurrent to the oil vapor in the reactor and the spent catalyst travels counter-current to the regeneration air in the Thermofor kiln.* Attrition of the catalyst particles due to handling through the mechanical conveyors is given as less than 1 lb. per bbl. of oil entering the reactor. This loss will naturally vary greatly with the character of the catalyst. If proper recovery of the dust were secured, reprocessing of the more expensive synthetic catalysts would probably pay.

In view of the apparent similarity of the fluid catalyst and TCC processes, there is every reason to expect equivalent results, when catalysts, temperatures, pressures, times of reaction and charging stocks are the same. The dif-

*See paper on Thermofor kiln in Proc. A.P.I. **20**, (111), 9 (1939); also paper on TCC process in Proc. A.P.I. **23**, (III), 59 (1942).

Battery of heat exchangers, developed to reduce operating costs



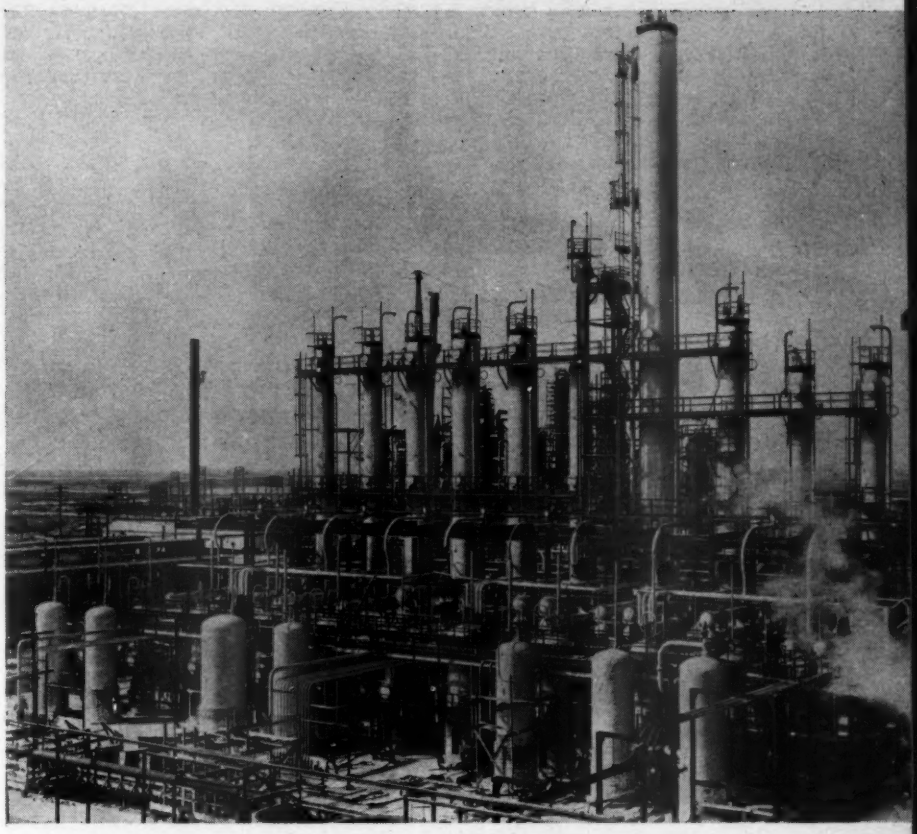
ferences are wholly mechanical and, in both cases, the processes are limited as to operating pressure by the head of catalyst that can be maintained on the reactor.

Two other catalytic-cracking processes have more recently been announced, but with little explanation. The one was described by Houdry Process Corp. as an adiabatic process to produce from naphtha an aviation gasoline "too good for existing engines." If a fixed catalyst bed were used in such a process, the time cycle would obviously be very short. The other process announced was called a "Cycloversion" process by Phillips Petroleum Co. It is a fixed bed catalytic process and is claimed to handle naphtha or heavier charging stocks to produce highly aromatic gasoline suitable for use in aviation gasoline as a blending material. Further developments in the field of catalytic cracking are to be expected, particularly in view of the importance of the product to the production of aviation gasoline of the desired performance characteristics.

Cycloversion, Hydroforming

Hydroforming, or catalytic reforming in the presence of recirculated gases containing hydrogen, is being widely used to produce, from selected stocks, certain aromatic hydrocarbons. In a similar manner these aromatics may be recovered from the products of catalytic-cracking operations charging gas oil, particularly those units using synthetic catalysts. Except for the recirculation of gases containing hydrogen the similarity of the processes is apparent to all. It is not therefore surprising to find aromatics in distillates from catalytic cracking, nor is it unexpected to see the effect of the synthetic catalysts upon the cyclohexane derivatives in the charging stock.

Much has been written about the production of aromatics from n-paraffins by catalytic processes which simultaneously dehydrogenate the paraffin, cyclize the olefin to a naphthene and dehydrogenate the cyclohexane derivative to an aromatic. Other sources of aromatics are obviously the dehydrogenation of cyclohexanes present in the petroleum and the dealkylation of complex aromatics also present. The selection of suitable catalysts and operating conditions to handle such naphthenes and aromatics may be expected to follow during this emergency period. The effect of such a huge production of aromatics from petroleum in the postwar period may be serious to the by-product coal industry. It is difficult to conceive of the possibility that all of these aromatic producing units will shut down when the war is over. It is equally difficult to imagine a resin and plastics industry large enough to absorb all of the aromatic naphthas which can be made by these plants.



Refining units are becoming progressively more complex as typified by this recent aviation gasoline unit

It would appear more probable that the margin between high-octane-motor-fuel price and aromatic-naphtha price will decrease in the same way that characterized the margin between V.M.&P. naphtha and gasoline during the last decade. The petroleum companies and the organic-chemical manufacturers may well start reflecting on what they can make from cheap aromatics which could not formerly be produced because of raw material cost. Nylon can scarcely be expected to take up all of the surplus!

Chemicals and Plastics

During the past year announcements were made of processes for the alkylation of benzene with ethyl alcohol or ethylene to produce ethyl benzene and with propylene to produce isopropyl benzene (cumene). In both cases, it was proposed to use existing catalytic-polymerization equipment to perform the alkylation reaction. The production of ethyl benzene by the petroleum industry would remove a considerable burden from the shoulders of the chemical industry and would relieve that industry from the necessity of building new alkylation equipment and catalyst manufacturing facilities. The chemical industry's process, as described by Dr. Willard Dow, at the Buffalo meeting of the American Chemical Society, requires the use of reasonably pure ethylene and anhydrous aluminum chloride. The oil-industry process uses the same catalyst that is being used for polymerization and can operate on a gas containing relatively low percentages of ethylene. With cheap benzene made from petroleum, and therefore very low sulfur content, it should be possible after the war to supply an abundance of ethyl benzene to produce styrene for both rubber and plastics. Whether cumene manufacture survives the war period depends upon the relative values of benzene, high octane aviation fuel and the cost of converting benzene to cumene.

Fig. 4 is a schematic flow sheet applicable to the manufacture of ethyl benzene or cumene.

Another process which is having a very important part in the aviation gasoline program is catalytic isomerization. The supply of isobutane naturally occurring in our production of petroleum and natural gas is either insufficient or too widely scattered to furnish all that is required for the production of alkylate. This necessitates the construction of plants to transform n-butane into isobutane. Several such plants have been in-

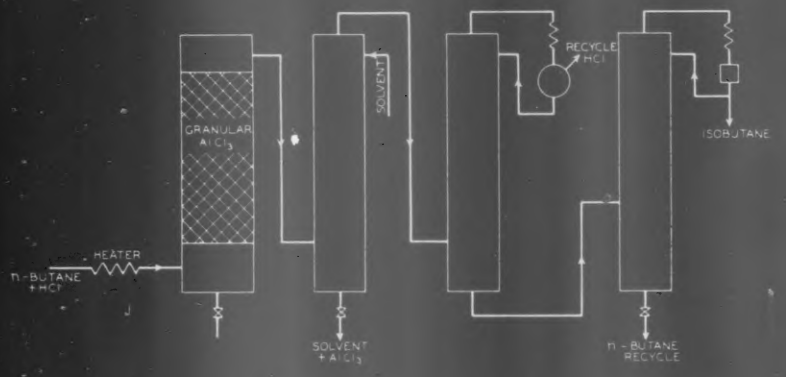


FIG. 5—ISOMERIZATION WITH ALUMINUM CHLORIDE HYDROCHLORIC ACID AS CATALYST

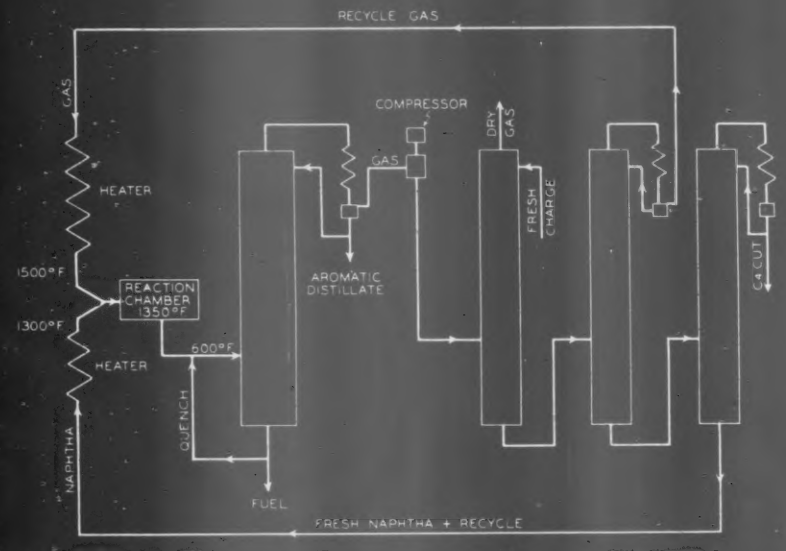


FIG. 6—TRUE VAPOR PHASE (T. V. P.) PROCESS

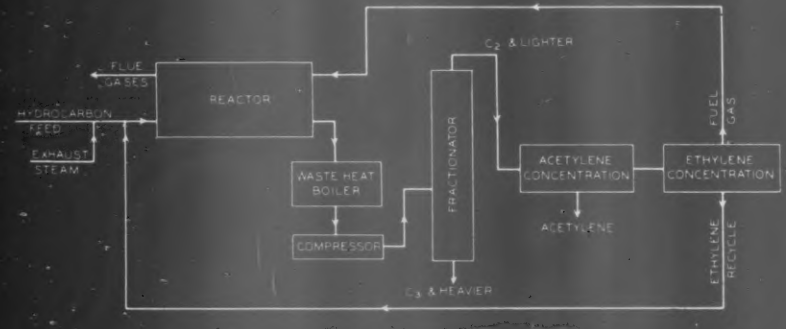


FIG. 7—THE WULFF PROCESS

stalled and are today producing thousands of barrels of isobutane which would never have existed but for the perseverance and inspiration of the research chemist and his associate, the chemical engineer. A simplified flow diagram of such a process is shown in Fig. 5.

The feed stock, n-butane, is passed through a heater along with a small percentage of anhydrous HCl and thence into a tower packed with granular $AlCl_3$ (anhydrous) which may be supported on an inert carrier, if desired. One process (Fig. 5) described in the patent literature employs a vapor phase operation at 150 lb. per sq. in. or higher, and a temperature of 300° F. or somewhat higher. Under these conditions $AlCl_3$ sublimes into the gases undergoing conversion and must be removed by scrubbing with a suitable solvent to avoid plugging and corrosion in the remainder of the apparatus. Under these conditions conversions of 50 per cent or more to isobutane are claimed to take place. The mixture of butanes and HCl is fractionated to recover HCl for recycle and then the butanes are separated in a suitable tower. The n-butane is recycled.

Isomerization

An adaptation of this process has been described by Standard Oil Co. (Indiana) for the manufacture of isopentane and isohexanes from n-pentane and n-hexane. Operating conditions have not been disclosed, although it is stated that the n-paraffins alone may be treated or a cut from crude petroleum containing them may be used as charging stock. In the treatment of n-hexane, it is claimed that excellent yields of neohexane (2,2-dimethyl butane) are secured.

A process announced by Phllips Petroleum Co. under the name of "Isoversion" is claimed to convert relatively valueless liquid constituents into essential products useful in making aviation gasoline and other war products. No details concerning the processes have been released to the public.

It is to be expected that further development in the field will enable commercial operation of processes to handle n-heptane and higher n-paraffins. Results of laboratory experiments described in the literature indicate that alkyl cyclopentanes may be converted into cyclohexanes and vice versa. In view of the fact that much larger quantities of these naphthenes are present than was thought possible a few years ago, it is not improbable that we shall find it desirable to perform these reactions on a commercial scale. For example, cyclopentanes dehydrogenate to form large quantities of gas, coke and olefins, whereas cyclohexanes dehydro-

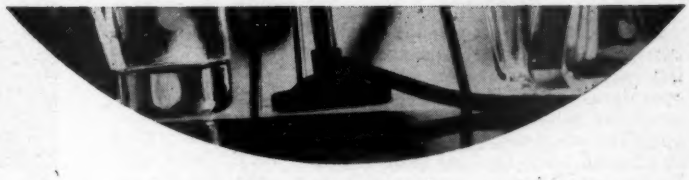
(Continued on Page 133)

While the rubber output originally planned for 1943 has been reduced to make way for more critical production, the present schedule is expected to take care of imperative needs with a small margin at the year's end. Long-range research is secondary to immediate requirements.

Synthetic-Rubber Development

Smoothing Out Some Serious Problems

by Arch L. Foster



PROGRESS in the synthetic-rubber program has been marked by what may be properly termed fluidity in plans and prosecution of them during the entire period of the effort to produce synthetically our requirements of this indispensable product. This situation now has become much more clarified and reduced to more exact and practical terms. The program to date is that during this year 43.6 per cent of the total synthetic program is to be completed and operating, to supply us with the absolutely critical amounts of rubber required for our military and all-essential auxiliary needs. This curtailment became necessary because of the conflicting needs of the directly military requirements for steel and other equipment and of the rubber industry for the same steel. Compromise was necessary and was made in the light of the most indispensable production for each.

As the butadiene program now stands a total of 656,860 short tons is scheduled to be completed finally, of which 220,000 tons will result from alcohol, 75,000 tons from butane, 265,100 tons from butene, and 96,760 tons by thermal cracking naphthas by the so-called "quick butadiene" program. This refinery-conversion program to obtain butadiene quickly was earlier scheduled to produce roughly 156,000 tons annually. Four plants for which conversions were planned for 1943 have been eliminated from the program, including Pan American at Texas City, Tex.; Standard of Indiana at Wood River, Ill.; Ohio Oil at Robinson, Ill., and Magnolia at Beaumont, Tex. These contracts were canceled because the jam on equipment and the priorities which could be given them in the light of their relative importance would not permit their completion in time to contribute materially to the supply of butadiene before the "regular" butadiene plants are completed and producing.

Picture of Program

As a result of these and other revisions the rubber program shapes up as follows: 813,000 tons capacity, or 78 per cent of the survey committee's recommendation is now building in various stages of completion, held up in many cases behind schedule in varying degrees by the practical inability of the steel and equipment companies to meet all demands as rapidly as original schedules required. The butadiene capacity to make 762,000 tons of rubber annually is on schedule, styrene equivalent to 798,000 tons of rubber, a slight unbalance which will be smoothed out when all plants are operating and their actual output known. By the end of this year it is expected that 241,000 tons of synthetic rubber will actually have been made. Estimated production for each quarter of the year are (short tons): First quarter, 10,800; second, 22,900; third, 70,700; fourth, 136,600; total, 241,000.

Reduction of neoprene and butyl rubber plans have also been made, neoprene being reduced from 60,000 to 40,000 tons annually, butyl from 132,000 to 68,000 tons. It is expected that by 1944 this reduction may be replaced by buna-S rubber; isobutene for butyl conflicts with the more indispensable aviation fuel (isooctane) alkylation requirements; and the military authorities state that except in cataclysmic emergency these rubbers will not be used for military tires. Over-all, the plans are to have 452,000 short tons capacity for all synthetic rubbers operating by the end of 1943.

Meanwhile, we had 440,000 tons of crude rubber in the United States on January 1, 1943, with a planned 241,000 tons of synthetic rubber, plus 35,000 tons of imported natural rubber—chiefly from the Amazon basin—we should have a total supply of 716,000 tons available for the year. Estimates of 612,000 tons are made for our total vital requirements, leaving only 104,000 tons as reserve at the end of the year, an uncomfortably low figure.

Some hopes are held out that imports of natural rubber will exceed materially the figure originally estimated by the Baruch committee. Brazil, Peru, Bolivia and Colombia are forcing broad and energetic programs of development of rubber extraction from their tropical forests. Much needs to be done in providing sanitary, healthful quarters and working conditions for the rubber gatherers in these areas. Mexico is looking into the situation; so are some Central American countries. Haiti is

cooperating with Rubber Reserve Co. in furthering the cryptostegia program, which cannot produce appreciable amounts before mid-1944. Our Government is also pushing work on guayule and Russian dandelion (koksaghyz) but these developments cannot bear fruit in time to relieve the present situation.

Altogether it is expected that next winter will see our serious period in rubber shortage and that more comfortable conditions will arrive some time in 1944, probably by midsummer. The full development of this program is contingent mainly on the ability of steel makers, fabricators and builders to make the equipment and build the plants on time while meeting the demands for crucial material for direct military purposes, and at the same time to keep our industrial machine going and the civilian population healthy and working. How much metal the spring offensive may require we cannot foresee.

Technology Improving, "Bugs" Expected

Operators of plants already producing butadiene and styrene are working as feverishly at perfecting their operations and increasing yields as are those who are still pushing construction of plants yet uncompleted. Much remains to be done in determining the actual output capacity of these plants. A large amount of data and experience is available on pilot-plant developments; considerable experience has been obtained in handling smaller commercial-size units, which information will be transmitted as far as possible to operators as yet without extensive experience. Yet it is not practicable to prophesy with exactness at present as to the actual capacity of the larger units. Hope is implied in the rubber director's second progress report that these plants will prove to have greater capacities than those for which they are designed. Some chance exists that this will be the case; however, it is at least a 50-50 chance that the practical capacity will prove to be lower than the rated capacity of the design calculations. Not enough is known now about large-scale production.

Because smaller amounts of equipment are reportedly required for the butadiene-from-alcohol process some have expected those plants to get into operation sooner than those using butane, butene and other hydrocarbons. Yields from the alcohol process vary in reports from different sources. The Russian process reports 22-25 per cent yields; even with the higher figure this results in only a 2.6 lb. of butadiene per gallon of alcohol. Yields of butadiene from butane reported vary widely, with figures up to 65 per cent being quoted; with a 50 per cent yield the output per gallon is approximately equal to that from alcohol, when starting from grain for alcohol as we eventually must inevitably do if alcohol is used as raw material, the amount of processing required to convert grains to butadiene is so much greater, and the cost of the alcohol itself is so much higher — the lowest creditable estimates place this cost in the proximity of 22 cents per gallon—than that of butane, 3 to 5 cents per gallon at most, the total processing cost with alcohol as base is increased by about 7 cents per pound by the one item. Whether or not the other processing costs are low enough to make alcohol competitive with butane or hydrocarbons has not been determined satisfactorily to all interested groups. It is highly probable that costs for both processes will be materially reduced as large-scale production gets under way. For the war period the all-im-

Above: Early this year Harvey S. Firestone, Jr., president of Firestone Rubber Co., in the presence of plant manager, E. T. Handley, and chief engineer, H. H. Waters, turned the main switch to start the first synthetic-rubber run on a new unit

Left: This "stirring machine" aids in drying the crude synthetic rubber after it comes from the coagulators and washers

portant cost is time, not cents.

Briefly, production methods for butadiene are four: From butane by a double-catalytic-dehydrogenation procedure, butane-butene-butadiene; from butenes obtained from cracked gases; by heavy thermal cracking of refinery naphthas known as the refinery conversion scheme; by dehydration-dehydrogenation methods on alcohol according to the Russian, Polish or other methods most or all of which have been developed abroad where the hydrocarbon supply, with the exception of Russia, is inadequate to supply needed amounts of raw materials.

The hydrocarbon route for butadiene must start with butane or equivalent; if butenes are used as starting charge, they must be obtained from some source in which dehydrogenation with or without molecular rupture is the primary reaction; butenes may come from cracking light gases or from the thermal or catalytic cracking of heavier hydrocarbons; in either case the process amounts to dehydrogenation of butane and any delineation of the process must include this primary dehydrogenation step. Many technologists believe that with our large supply of normal butane available from both refinery and natural-gasoline-plant sources, butane is the proper starting point for any permanent synthetic-rubber industry supply of butadiene, and that normal paraffins are the starting material for any supply of dienes. Whatever portion of the required amounts of dienes may be obtained as a byproduct of other refinery operations, thermal or catalytic cracking, etc., merely will relieve the demands on the units producing the bulk of the dienes by direct dehydrogenation methods. Obviously the cracking of naphthas is an emergency measure excused only by the imperative demand for synthetic rubber at any monetary cost during the emergency. Under normal economic conditions the low yields of dienes and the waste products unavoidably made by this process place too great a financial load on the primary product, dienes, to enable it to compete with more efficient processes, some technologists believe. Indications are that the final solution of the diene-manufacturing problem lies between two processes, that from alcohol and that employing hydrocarbons. Time only can give the answer, and it remains within possibility that light-oil cracking may be developed to a point where it may compete economically with the processes starting with C_4s or C_5s, especially if paraffinic naphthas become a drug on the motor-fuel market because of the high-octane-rating demands for postwar fuels, and if the products other than dienes made by naphtha cracking are developed to give yields and properties which contribute constructively to the manufacture of improved motor fuels, plastics, petrochemicals and other materials of postwar usefulness.

While assuming no part in the emergency rubber program a great deal of research is being conducted by several laboratories on the manufacture and properties of other dienes, isoprene, piperylene and other C_5 dienes. The introduction of these materials into synthetic-rubber-like products may have an important effect on properties of rubber and will introduce also another variable which may be used in any number of as yet unknown ways to vary the properties of different rubbers for different purposes. This will of course expand the applications of rubber synthesis and the versatility of the products which can be made, to meet specific require-

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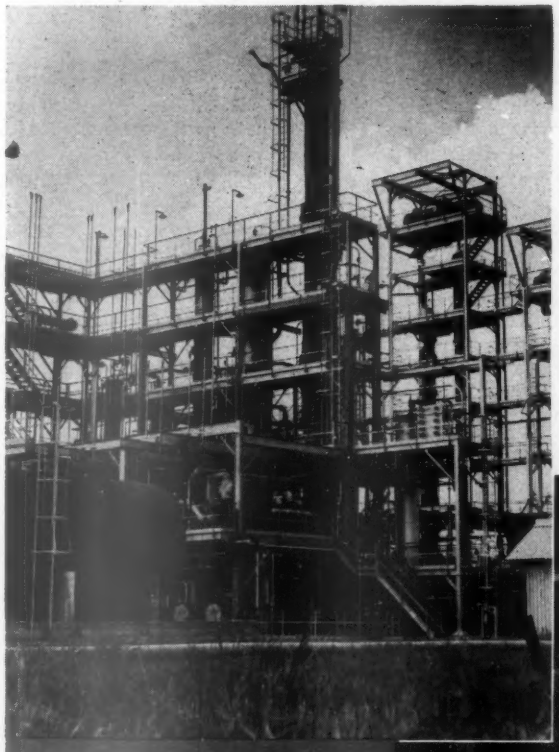


Above: Butadiene plants such as are rising in many unannounced locations throughout this country to feed the rubber polymerizing units

Right: Cloth rubberized with the synthetic product is employed in making observation and other types of military equipment

New Processes Require More Powerful Automatic-Control Equipment

by J. B. McMahon *

New catalytic cracking alkylation and other processes require control equipment capable of moving valves and other regulators against considerable resistances. Automatic control under these conditions for steam-making and similar operations has been fairly well worked out. The equipment used for these purposes may be adapted to the new refinery processes. This article shows the principle of these control systems and why they perform the job better.

THE new catalytic-cracking processes have served to emphasize a trend in the general refining field to heavier and larger mechanical equipment. This increase in size of equipment has presented new problems to the automatic-control engineer, as the ordinary air-operated diaphragm motor, which has been the handy jack-of-all trades as the power device in automatic-control work in the refinery, possesses very definite limitations as to stroke and the available power it can exert. It does not possess the ability to overcome the large inertia and friction of the large slide valves, butterfly valves, dampers and turbine gear of the newer processes.

The increase in size of cracking and other refinery units has led to a much more widespread use of butterfly valves, instead of balanced poppet valves, in the larger sizes. Butterfly valves are much less complicated than poppet valves, and therefore require considerably less machine work, and use considerably less critical material, being much lighter in weight. However, butterfly valves do not act as balanced valves, but rather as though about one-third of the total vane area were unbalanced. This effect is most evident in the nearly closed position, where the greatest requirement for accurate positioning of the vane occurs. The unbalanced force varies directly as the pressure drop and as the cube of the diameter. Therefore, when they are used on applications where appreciable pressure drops—anything over a few ounces—exist, ordinary diaphragm motors are incapable of operating them.

For these reasons, automatic combustion-control regulators for large boilers and steel mills have used piston-operated power units to move and position accurately these large dampers and butterfly valves.

Contributing also to the reasons for using piston operators rather than diaphragm motors in combustion-control practice has been the difference in basic requirements of automatic control performance. Practically all refinery operations, with relatively few exceptions, are based on the maintenance of constant conditions throughout the whole process. The charge, which is the main load, is generally maintained under automatic constant rate-of-flow control. Load variations, therefore, are due mainly to the unmeasurable changes in charge composition, or the slowly changing influence of such factors as the weather.

Speed of response of measuring elements, and correlatively, speed of response of operating elements, are therefore much more important relatively than they are in the average refinery operation. In some cases,

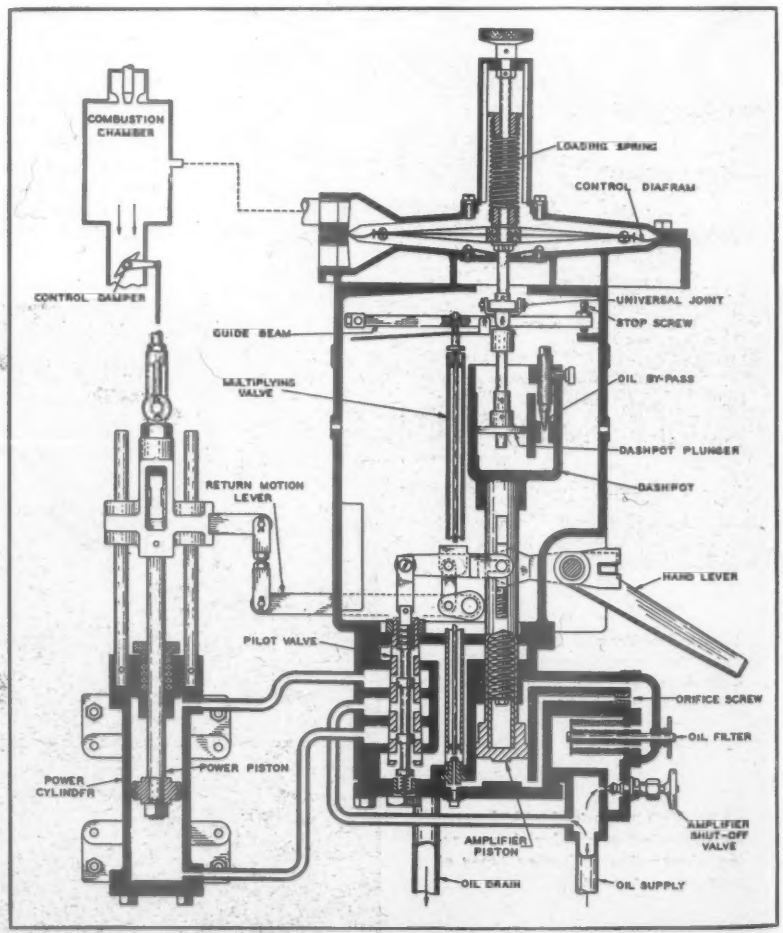


Fig. 1—Hydraulic regulator

*Engineer, Republic Flow Meters Co.

SUPERIOR QUALITY

in every detail

1 **GLASS AFFORDED EVERY PROTECTION.** Frame completely contains the glass so that no part is exposed. Weight of frame entirely supported by liquid chamber gland . . . not by glass.

2 **UNIFORM GASKET PRESSURE ASSURED** by accurate finishing of the retaining surfaces to very close tolerances.

3 **EQUAL RESILIENCE ON BOTH SIDES OF GLASS** due to interchangeable gaskets which also eliminate possibility of improper reassembly in field.

4 Spacing band centers glass and prevents contact with metal.

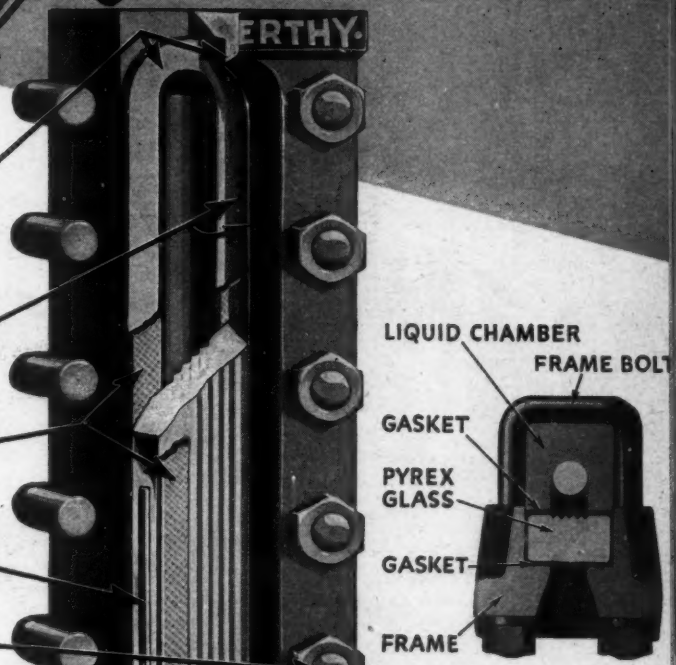
5 **PERFECT GASKET JOINTS WITH MINIMUM BOLT TENSION** because misalignment of parts is impossible, which also eliminates frequent cause of glass breakage.

6 **DISTORTION PREVENTED** by reinforcing beam and scientific distribution of metal in frame. (Distortion causes excessive strains in glass and results in breakage.)

7 **GASKET BLOW-OUTS PREVENTED** by full metal backing of entire surface and periphery of both gaskets.

8 **RIGIDITY AND PERFECT ALIGNMENT** are assured by machining liquid chamber from a solid block of temperature resisting steel heat treated to prevent warping.

9 **PYREX GLASS** is used exclusively because of its greater strength and resistance to thermal shock and erosion. Exhaustive comparative tests have proven conclusively that Pyrex glass is the highest grade obtainable for the service.



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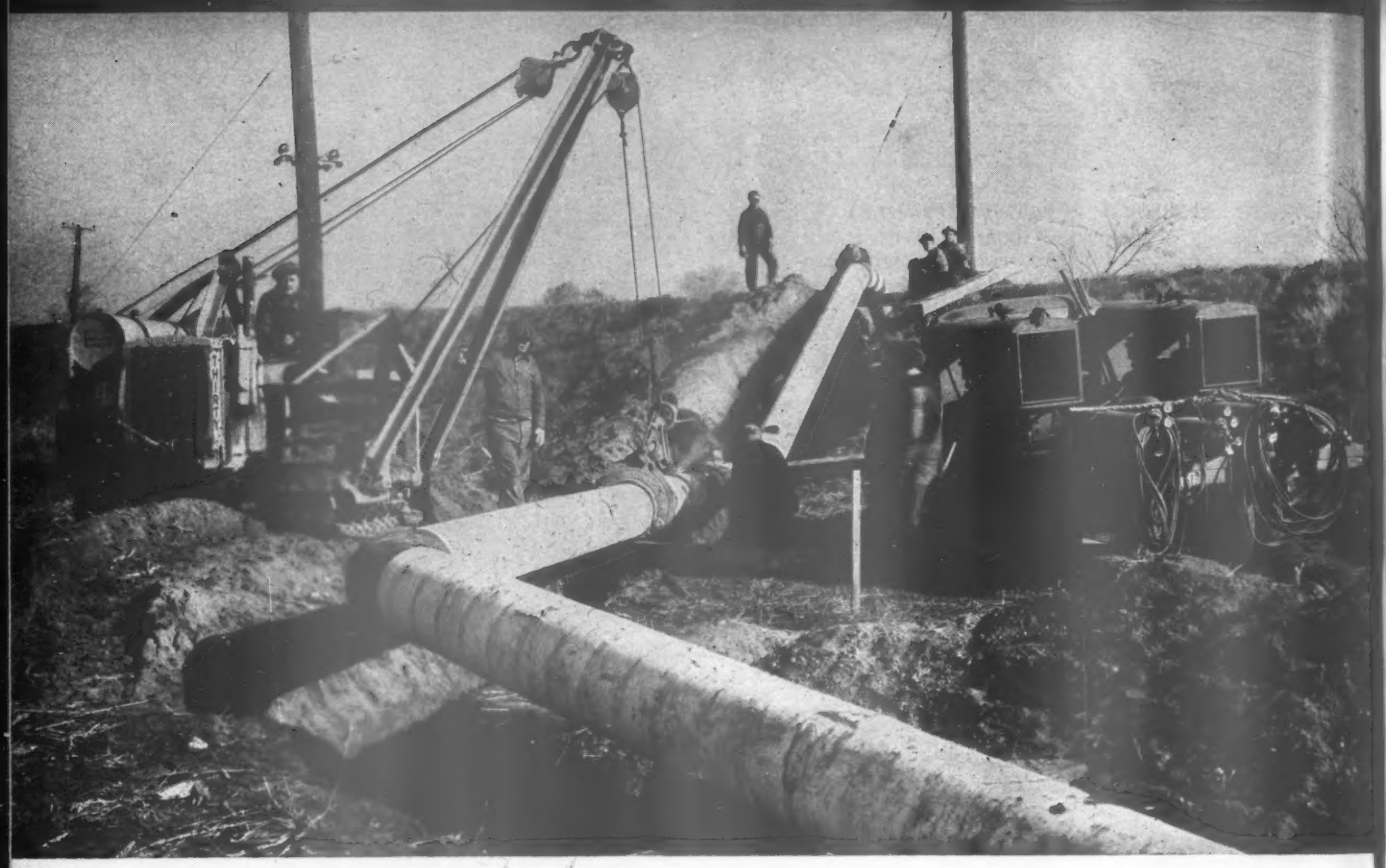

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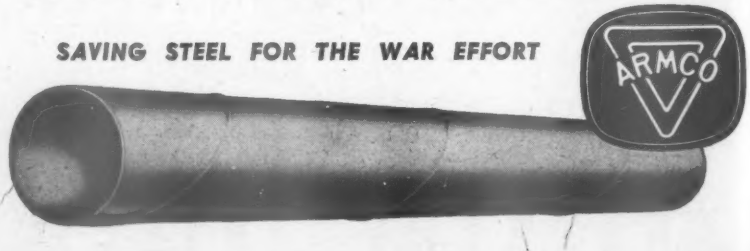


speed of response of the complete regulating system is absolutely vital. Such a case is that of a topping turbine bypass desuperheating and reducing station. If for any reason, a topping turbine goes out of service, it is necessary to open the bypass around it and start reducing the steam pressure and desuperheating the steam temperature to the values required for the lower-pressure turbines, quickly enough to prevent the lower-pressure turbines from going off the line. This may be a matter of seconds. Specifications for such equipment frequently call for such reducing and desuperheating stations to be able to get into operation in less than 10 seconds. In fact, specifications have been written, and met, calling for such a station to be in stable operation in less than 4 seconds.

Speed and Power

The inherent speed and available power of piston operators have caused them to be used for such service. Such a pressure regulator, hydraulically operated, is shown in Fig. 1. Oil under pressure exerts a force on the top of the amplifier piston. Oil admitted through an orifice exerts an opposing force on the bottom of the amplifier piston. Since the effective area of the top side of the piston is approximately one-half that of the bottom side, in balance the multiplying valve stem must allow the oil to bleed out of the multiplying valve at such a rate that the pressure below the amplifier piston is approximately one-half that above it. If the measured pressure increases, the control diaphragm will move down slightly, causing the multiplying valve stem to slightly close off the multiplying valve. This will raise the pressure below the amplifier piston until the unbalanced force across the piston equals the unbalance of force between the control diaphragm and the loading spring. This unbalanced force will be exerted on the dashpot, and the plunger in it will cause oil to be forced through the bypass needle valve at a rate proportional to the force. This will in turn permit the dashpot, and hence the amplifying piston to move upward at a rate proportional to the change of pressure on the control diaphragm.

Connected to the amplifier piston, through the return motion linkage, is the four-way pilot valve. As the amplifier piston moves up, the pilot valve will move down, admitting oil to the bottom of the power piston, and opening the drain line to the top causing it to move upward. If the piston does not move for any reason, the whole oil-supply pressure produces an unbalanced force on the entire piston area. As the piston moves, the return motion linkage restores the pilot valve to neutral. Thus, for every position of the amplifier piston there is a corresponding position of the power piston, and the rates of motion of the two are identical.

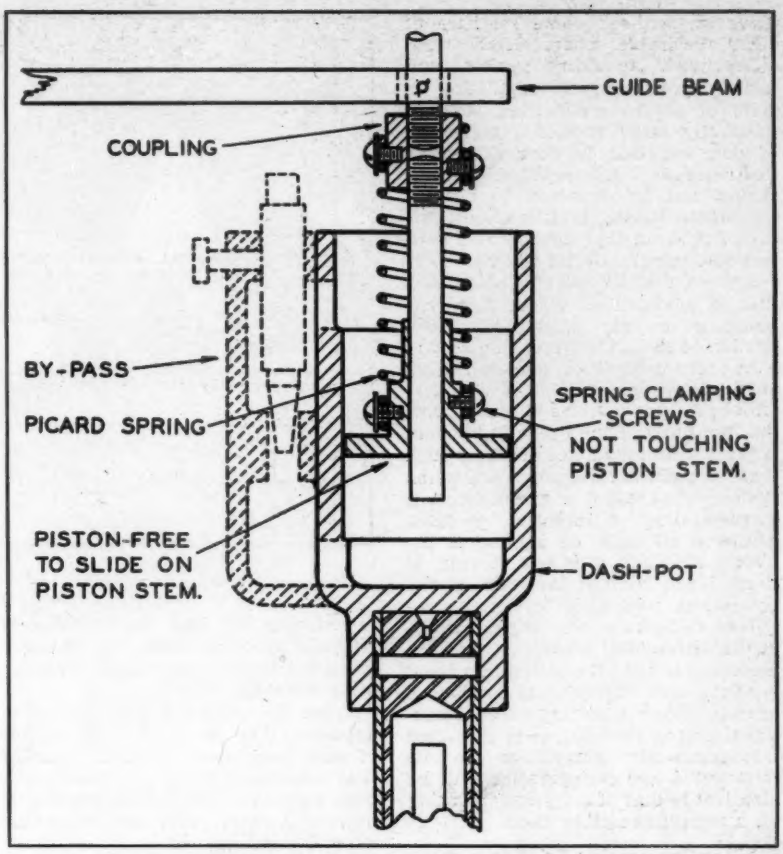


Fig. 2—Section of single dashpot showing Picard spring

The motion of the power piston repositions the damper, which corrects the inaccuracy of pressure. As the pressure returns to normal, the force differential between the control diaphragm and the loading spring becomes less, which in turn causes the force difference across the amplifier piston to become less, so that as the pressure approaches the desired normal value the amplifier piston moves at constantly decreasing rate of change, until at balance the amplifier piston, and hence the power piston and damper, have assumed whatever position is necessary to restore the pressure to normal without overshooting or permanent cycling. The dashpot bypass needle valve is adjustable to permit the power piston to move at the maximum speed possible without causing "hunting."

Where regulation involves pronounced time delay, as in the case of turbine-driven pumps, a temporary characteristic is introduced into the regulator action by means of a Picard spring, named for Professor Picard who developed this principle with Rateau—of Rateau turbine fame. When this spring is used, the dashpot plunger is made free to slide on the stem as illustrated in Fig. 2. One end of the spring is connected to the plunger and the other to the coupling. Therefore, when the measured pressure departs from normal, the amplifier moves immediately whatever amount is necessary to compress the spring an amount equal to the unbalance in force between the measuring diaphragm and the loading spring. Thus, a movement of the power piston is secured equal to the amount of unbalance. As the balance becomes restored, the regulator reverses its action until the compression has been released. In the meantime, the dashpot plunger has slowly moved with relation to the dashpot and has taken a new position necessary to fulfill the new load conditions. At the new balance point, the Picard spring is completely relaxed and the regulator is again in true balance.

Pneumatically operated regulators are available which work on substantially the same principles. They possess the advantages that they can operate from plant air supply, which is generally available conveniently. No return lines to the pumping unit are necessary, as is the case with oil-operated regulators, and slight leaks in compressed air equipment and lines are not as objectionable as they are with oil-operated equipment. These advantages are not gained,

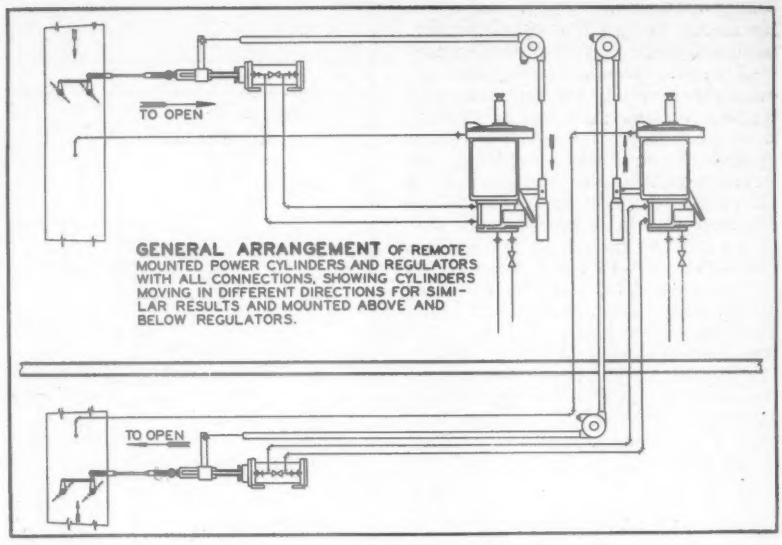
however, without some sacrifice of other desirable characteristics. An oil-operated actuating system will usually produce good regulation in spite of severe difficulties, such as unusually large frictional resistance of dampers due to poor design or maintenance. Air-operated control should not be expected to operate equipment having high friction. This does not mean that air-operated control equipment will not work successfully, but that its use should be limited to applications where frictional resistance is only a relatively small portion of the total forces involved.

In order to produce a motion of an air-operated relay cylinder, a differential pressure must be applied across the two faces of the operating piston. If there is an unbalance of forces such that, to maintain a fixed position the system must exert a given force, a corresponding differential pressure would at all times be applied to the piston, although it is not moving. If there is no friction involved in the equipment which the system is required to operate, any slight change in the differential pressure from that necessary to hold the piston in a fixed position, will immediately produce a motion. When operating without frictional forces the system is therefore instantaneously responsive to its pilot valve and its operation will be identical to that of a system operating on a noncompressible fluid.

Overcoming Friction

In order to overcome the friction, a relatively high differential must be built up across the system to cause the apparatus to move. If this differential has to overcome frictional forces, the starting friction is usually very much higher than the running friction. This means that a high differential pressure must be applied to start the equipment, while a very much lower differential pressure will suffice to make the equipment continue to move.

The usual result of such operation is that the high differential necessary to start the equipment will cause the system to overtravel due to the much-reduced running friction. Of course with most regulators the pilot valve will reverse the air-pressure differential as soon as the piston has overtraveled, but due to the time lag of introducing air into the cylinder, a phase difference results which may cause continuous pumping of the operating cylinder.



GENERAL ARRANGEMENT OF REMOTE MOUNTED POWER CYLINDERS AND REGULATORS WITH ALL CONNECTIONS, SHOWING CYLINDERS MOVING IN DIFFERENT DIRECTIONS FOR SIMILAR RESULTS AND MOUNTED ABOVE AND BELOW REGULATORS.

Fig. 4

From the above description, it is apparent that the controlling action of such regulators parallels exactly that obtained from the instrument type automatic controllers developed in recent years, with two important exceptions:

First, the floating, or dashpot, control action is the primary function with the proportional factor added by means of the Picard spring, if necessary, whereas in instrument type controllers the proportional effect (throttling range) is the primary function, with the floating (automatic reset) added, if required. This is due in turn to two factors: (a) That the application on which the combustion control type regulators were applied possessed little inherent process lag themselves, while the development of instrument type controllers came about largely through temperature applications, where process lags are apt to be severe; and (b) the measuring element of the regulators were very specifically designed to avoid adding any measurement lag to the process lag, while in the instrument controller field, particularly in temperature control, this has been to a large extent impossible.

Second, the use of the force-balance, as the means of measuring deviations of the controlled variable from the desired normal, both permits and requires the use of heavy, rigid parts without causing any sacrifice in sensitivity, accuracy or responsiveness. However, this precludes the construction of this type of regulator as a combination indicating, or recording instrument, and controller, as there is no visible motion of the measuring element. Separate instruments must be used to provide visual indications, or records, of the controlled variables.

Since the basic regulator action is the same for any type of variable, the regulator mechanism is standardized, while the measuring elements are interchangeable.

Where it is necessary to maintain a definite relation between two variables, so that as one—the primary—changes in value, the other—the secondary—will be caused to change automatically in correspondence with the first, a variety of methods are possible with combustion type control equipment. A simple means is shown in Fig. 3, where the force produced by differential pressure in one element is exerted on a weigh beam. Unless the force exerted by the other element matches that of the first, the unbalance in the weigh beam will produce regulator action until balance is brought about. An adjustable weigh beam permits changing the ratio—in operation—if necessary.

Combustion control practice has grown up around the "master control" system, wherein a single variable—the steam header pressure—is automatically controlled constant by varying the fuel and air as necessary, keeping the fuel and air flows in a definite ratio, regardless of load. This

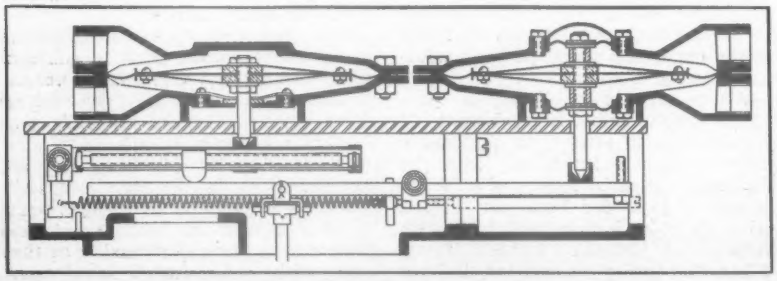


Fig. 3—Sectional view of type GA measuring element

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is done by putting individual regulators on the fuel (or fuels) and changing the loading on them simultaneously. The "master controller" sets up a loading pressure on the flow (or pressure) regulator weigh beams. The ratio may be changed as desired, either by means of adjustable weigh beams, or by ratio valves on the air-loading lines. Means have also been worked out for firing several fuels simultaneously, and in any desired proportion, at the same time providing the correct total quantity of combustion air regardless of variations in total fuel requirement.

Sometimes there are very good reasons why it is not practical to locate the regulator immediately adjacent to the valve or other apparatus it operates. In such cases, the power cylinder may be mounted adjacent to the valve or other final control element, with the return motion to the regulator pilot valve accomplished by a flexible cable, as illustrated in Fig. 4. Frequently, it is necessary to forego any kind of direct mechanical linkage between the regulator and the final control element. In such cases, a piston operator is used which produces a definite position of the piston for every air pressure received by it from a master or other impulse. Such a power operator is shown in Fig. 5 which illustrates a pneumatic operator. Operation is as follows: When the loading pressure is zero, the power piston and loading diaphragm are at the tops of their strokes. Increase of loading pressure from zero causes the diaphragm and its stem to move down.

Since the left end of the balancing lever pivots on the cam follower lever, which in turn pivots at its right end on a pin mounted in the case, downward motion of the diaphragm stem moves the pilot valve link down. This moves the pilot valve down to admit air to supply pressure to the top of the power cylinder and vent air from the bottom, thus moving the power piston down. Downward motion of the power piston is transmitted through the return motion linkage, cable and cam sheave to the compensating cam, rotating it counterclockwise. As the cam rotates, the cam follower on the left end of the cam follower lever, held in contact with the cam by the follower spring, will therefore move down an amount determined by the shape of the cam. This causes the pilot valve link and the pilot valve to move up, returning the pilot valve to neutral and stopping the power piston just as it reaches the new position required to correspond with the increased loading pressure. A hydraulically actuated operator works in substantially the same manner, except that a power-operated pilot valve is used, in order to handle the necessary volume of oil. A diagram of this pilot valve is shown in Fig. 6. The return motion cam may be cut to provide any relation desired between diaphragm pressure and piston position. This is frequently very desirable, as by this means an undesirable valve-flow characteristic can be made into an effectively desirable, or at worst, acceptable, characteristic.

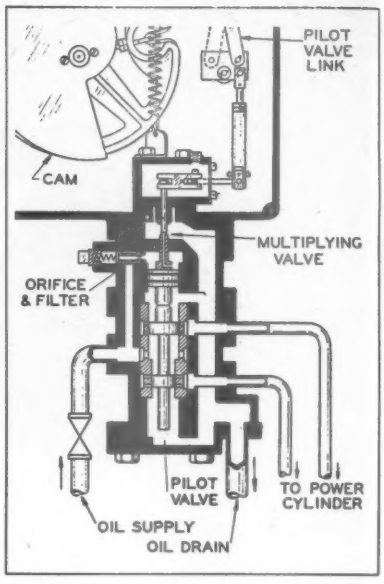

Fig. 6—Diagram of pilot valve of Series 72 operator

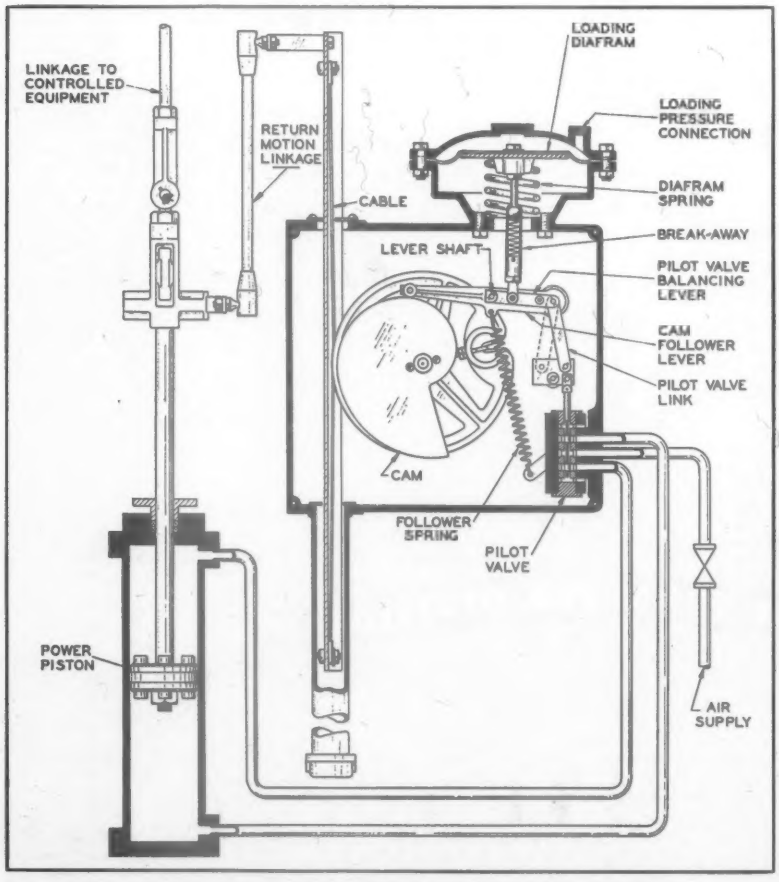

Fig. 5—Diagramatic cross-section through Series 73 pneumatic operator

Such equipment has not been used commonly in petroleum-refinery control work heretofore, but there are many control applications where it might be used to very good advantage, in addition to those where power requirements necessitate such mechanisms. The inherent over-all speed of response which they possess may prove to be the answer to some of the problems which are quite bothersome when conventional instrument type control equipment is used. For instance, the close fractionation required in separating the various isomers for alkylation and isomerization, commonly called superfractionation, in turn requires a much more precise degree of back-pressure control. A combustion-type regulator can be used for this service, arranged for master loading, the loading being furnished from a hand-loading station on the panel, thereby retaining both the control performance of the close-mounted regulator and the convenience of remote setting. In other cases, problems of parallel, sequence and totalizing operations have never been too well solved. All these have been well worked out in the field of automatic combustion control.

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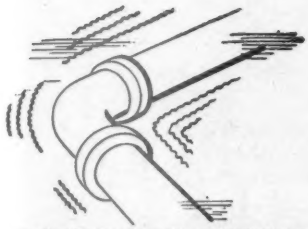

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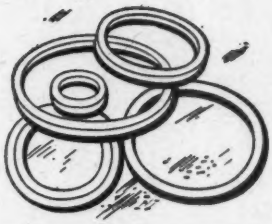

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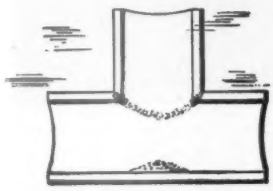
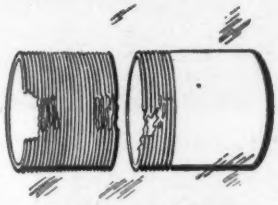


SLAG ACCUMULATION

Butt welds with Tube-Turn fittings virtually eliminate danger of slag.



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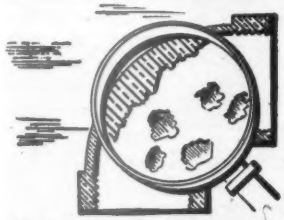

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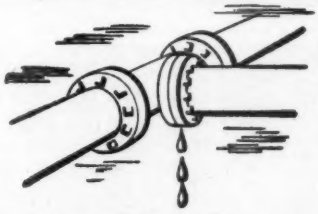

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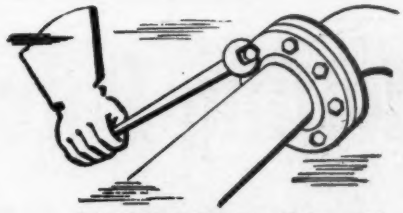

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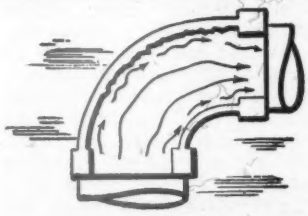

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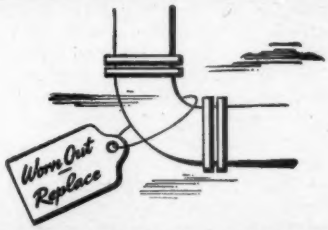

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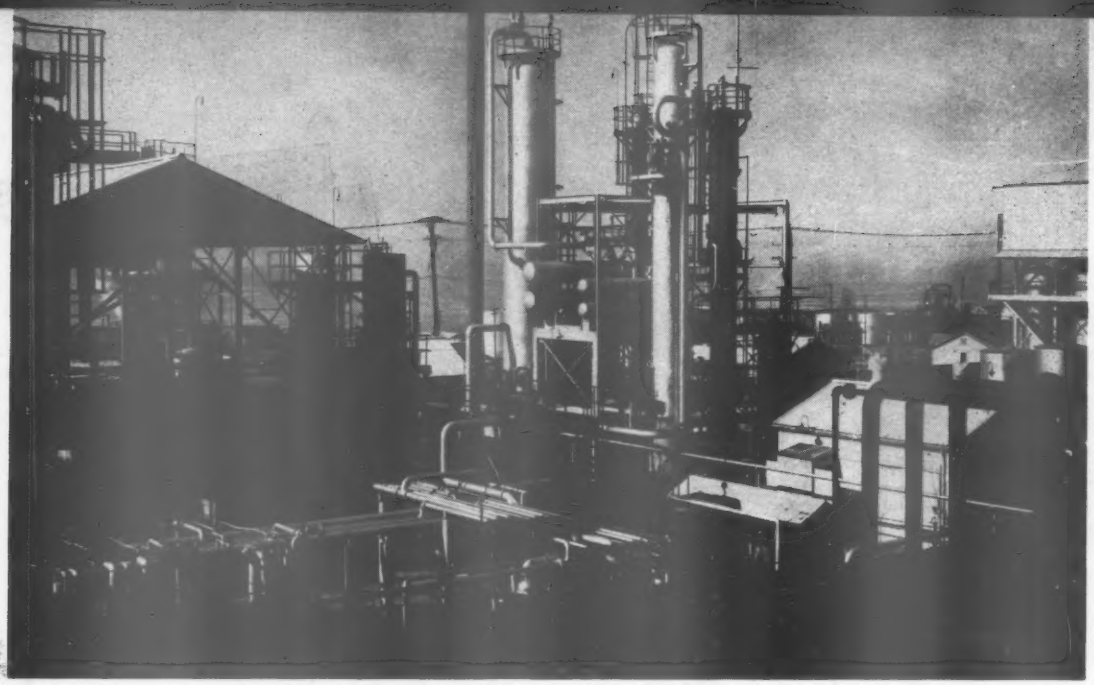

General view of Union Oil Co.'s wax-refining plant, Oleum, Calif.

REFINING of High Melting-Point WAXES

Rates and time of chilling; solvent and solvent ratio employed; temperature and rate of chilling and several other factors are important in manufacturing high melting-point waxes. This article outlines procedures which ample experience has shown to be optimum for this process.

by Vance N. Jenkins*

A LARGE proportion of the modern paraffinic-type lubricating oils are produced from mixed-base crudes by various combinations of different distillation, solvent extraction, and solvent dewaxing processes.

For example, in one refining method used in the refining of crudes containing a fairly high percentage of asphalt, the crude is first passed to a two-stage distillation unit where the lighter components are flashed off under about 10 lb. pressure and an S.A.E. 10 grade lubricating distillate is removed under vacuum. The residuum from this operation passes through additional heaters into a second vacuum column from which are drawn three side cuts for processing to S.A.E. 20, S.A.E. 40, and S.A.E. 60 grade oils. The residuum from this operation is an asphalt of 160°-165° F. melting point. These side-cut distillates are solvent dewaxed, the dewaxed filtrates are solvent extracted, and the raffinates obtained then clay-treated to produce finished oils. The finished S.A.E. 10 grade product is similarly produced from the vacuum distillate from the two-stage crude unit. The S.A.E. 30 and 50 grade products required to complete a full line of lubricating oils are prepared by proper blending of these basic products.

In a modification of this method the primary waxy lubricating-oil distillates produced under vacuum are solvent extracted before dewaxing and the resulting waxy raffinates are then solvent dewaxed; the filtrates obtained being clay treated to produce the finished basic oils from which the remaining S.A.E. grades required are blended.

Solvent Extraction of Oils

In another method of refining used quite widely, the more volatile components are flashed from the crude to leave a long residuum containing all of the lubricating oil fractions. This long residuum is then solvent extracted, the Duo-Sol process usually being used if the long residuum contains an appreciable amount of asphalt. The waxy long residuum raffinate produced is then solvent dewaxed and the dewaxed filtrate obtained is vacuum distilled to produce cuts of desired viscosities which are then clay treated. These basic finished oils are used to blend the remaining S.A.E. grade oils required. The heavy residuum from the vacuum distillation of the solvent-extracted, dewaxed long residuum is clay treated to yield a bright stock.

This last method of operation is modified in some instances by subjecting the long residuum to a propane deasphalting operation before it is solvent extracted. This operation is usually necessary if the long residuum contains an appreciable amount of asphalt and if a solvent extraction process other than the Duo-Sol process is to be employed in the further refining of it. It is obvious that, regardless of the particular order in which the individual steps are combined and of the particular solvent extraction or solvent dewaxing process employed, all of these refining methods have one thing in common. This common factor is the production by the solvent dewaxing processes of crude waxes composed of high melting point waxes and high viscosity

*Research Supervisor, Union Oil Co. of California, Wilmington, Calif.

oils. These crude waxes cannot be refined to yield oil-free waxes by the conventional sweating process, and lack of a satisfactory process, and refining them results in an economic waste of potentially valuable material.

In view of the high market value of the high-melting-point crystalline-type waxes potentially available from these crude waxes, it is rather remarkable that over the long period of years they have been produced there has been no generally accepted method of refining developed to handle them. The writer is aware of only three processes designed to produce fully refined waxes from such crude waxes that have ever been tried commercially. One process,* stated to be the first new deoiling method developed in two decades, was described first in 1940. Several installations of this process have been made during the past 2 years. As originally described, this process appears to be most applicable to the deoiling of the lower melting point waxes.

A second process,† believed at this time to be limited in use to a single installation, was described first in 1941. This process would seem to be applicable to the deoiling of crude waxes having a fairly wide range of

*A. H. Schutte, World Petroleum, Vol. 2, No. 11, Oct. 31, 1940, pp. 82-87.

†D. A. Young, The Oil and Gas Journal, Vol. 40, No. 11, July 24, 1941, pp. 34-37.

Chillers for wax crystallization, Union Oil Co. plant

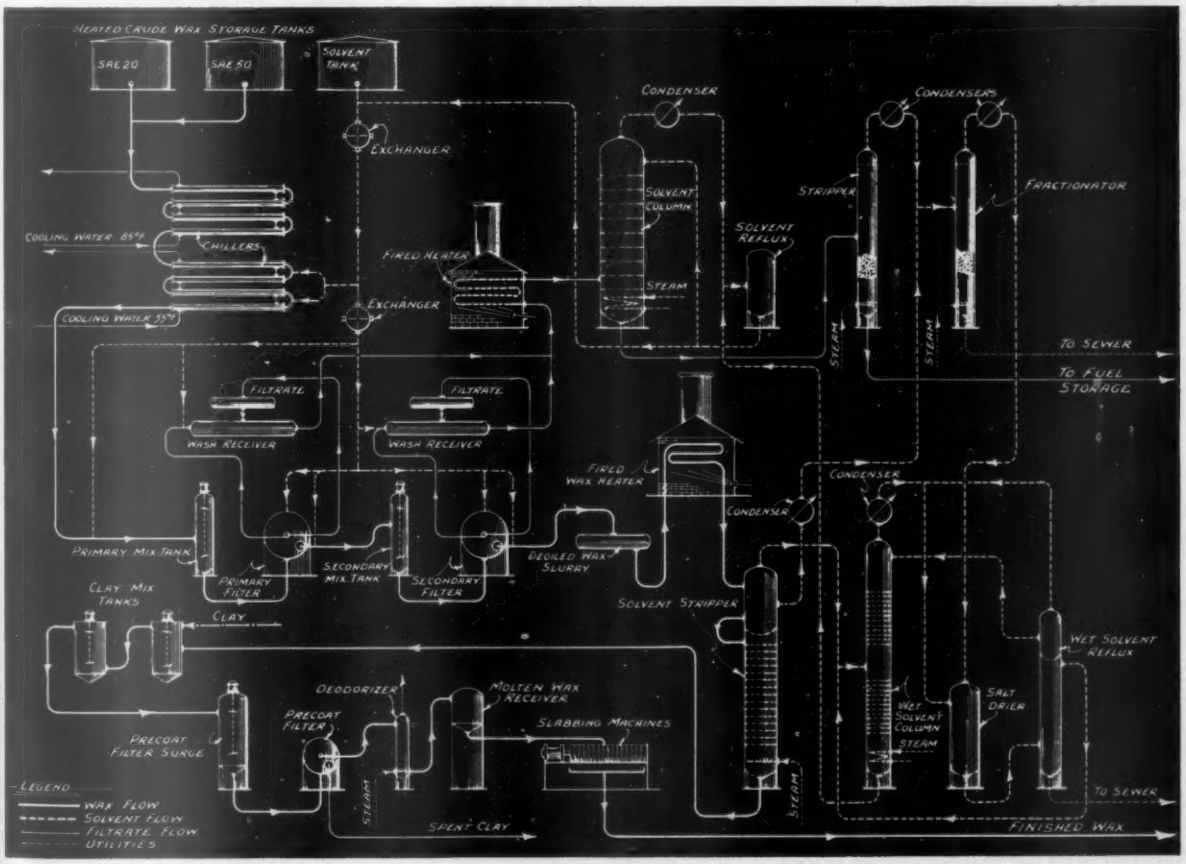

Fig. 1—Complete flow chart of wax-refining process

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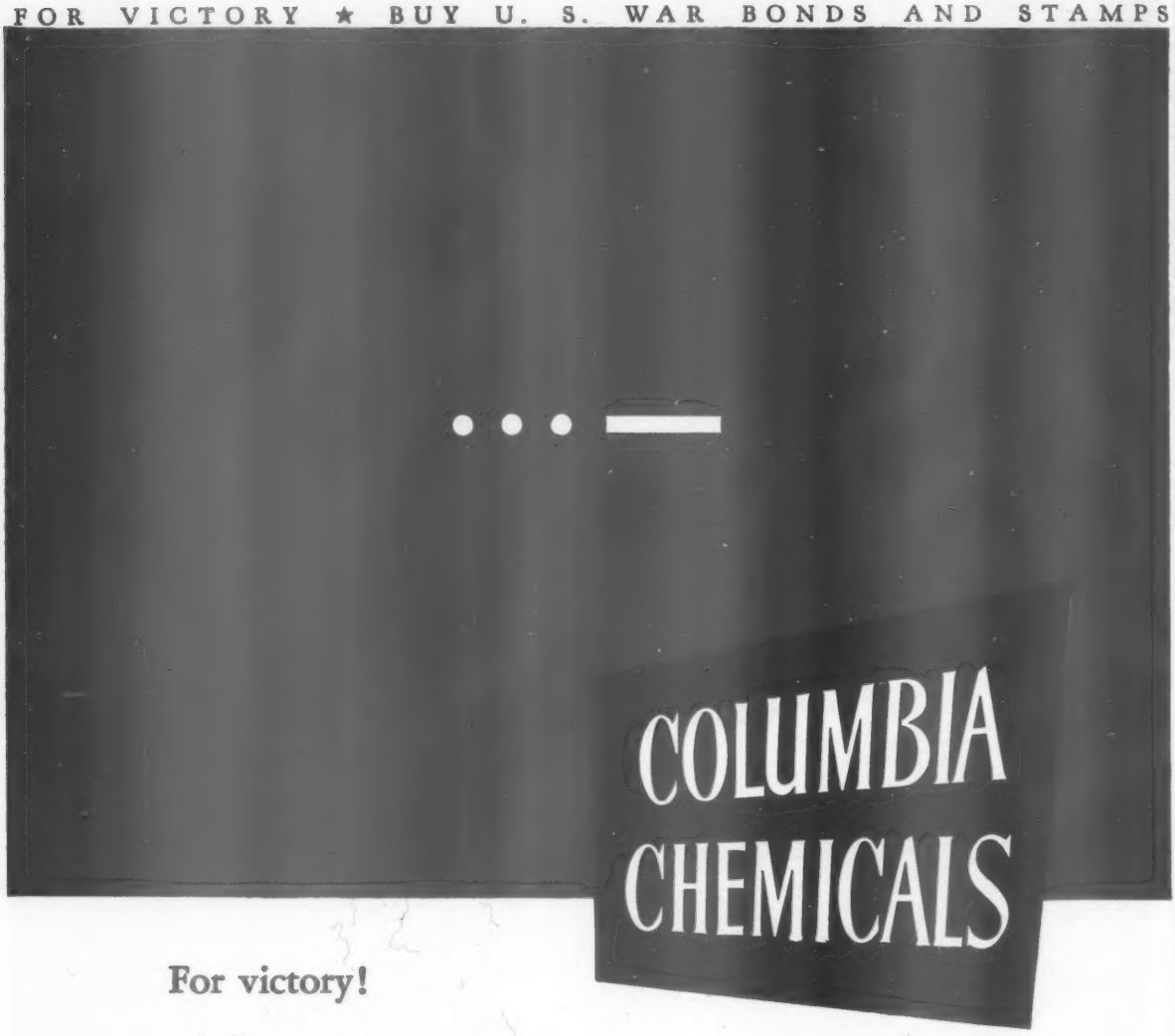

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melting points and oil contents.

A third process* the commercial use of which at the present is limited to one installation, was developed by the author as the result of experiments initiated in 1936. The development of this process, which is applicable to the deoiling of any crystalline-type wax, and the description of the commercial plant now utilizing it for the production of 10 to 12 tons per day of 145°-150° F. and 160°-165° F. American melting point fully refined waxes at the Oleum refinery of Union Oil Co. of California form the subject of this paper.

The idea underlying the development of this deoiling process resulted from observations which led to the conclusion that, regardless of its melting point and contrary to certain statements in the literature, a straight-chain paraffin wax separates in an oil-free condition when crystallized from the oil with which it normally is associated. It soon was realized that if this conclusion was true it might be possible to devise a relatively simple deoiling method utilizing this discovery which would be applicable to any crystalline-type wax, regardless of its melting point. A laboratory study of the characteristics of various crude waxes soon verified this conclusion.

Crude waxes of the type under discussion normally melt around 120°-140° F., and are quite hard solids at room temperature. The oil content of such waxes may vary from as low as 20 to as high as 65 per cent by volume, depending upon the nature of the waxy oil from which they were derived and the particular dewaxing process used.

*U. S. Pat. 2229658.

It was found that the solidification of such waxes, upon cooling to atmospheric temperature from the melted liquid state, could be prevented by continuous stirring of them during the cooling operation. Under such conditions the wax crystals separating from the oil did not interlock to form a rigid structure. Thus, instead of a solid mass being formed, smooth semifluid slurries or stiff plastic mixtures of wax crystals in oil were obtained. The relative fluidity of the slurries obtained varied with the viscosity of the oil and the amount of it present in the crude wax; those waxes having a low content of high viscosity oil giving the stiffest slurries. However, it was found that slurries having desired fluidities could be prepared from any crude wax by slight dilution of the material with additional oil either before it was cooled or during the cooling operation. As will be shown later, the nature of the diluent oil used is of major importance in the commercial process now operating and obtaining refined, oil-free wax from such slurries.

High-Melting-Point Wax

A laboratory study of the slurries formed in this manner showed that essentially all of the high-melting-point wax present had crystallized from solution in an oil-free condition before the mixture reached room temperature; most of it separating at temperatures above 95°-100° F. In the case of most of the crude waxes studied the valuable high-melting-point waxes present represented approximately one-half of the total wax content.

It was found that by the use of an appropriate solvent under proper conditions these valuable high-melting-point components could be recovered in an oil-free condition by an operation involving the simple extraction or leaching of the oil from properly prepared slurries of the crude material.

The characteristics indicated for an appropriate solvent for this purpose were that it should be completely miscible with the oil present in the crude wax and yet have low solvent power for wax; it should not swell or solvate the wax crystals; it should have a low viscosity; it should have a relatively low boiling point and should be stable with respect to decomposition on distillation. Methyl ethyl ketone was found to be a satisfactory solvent for use with crude waxes containing low or medium viscosity-index oils, while methyl ethyl ketone to which about 10 per cent of a light hydrocarbon boiling in the same range had been added was found to be suitable for processing crude waxes containing high viscosity index oil.

The proper conditions indicated for the extraction or leaching operation were that the crude wax should be in the form of a mobile slurry and thus capable of being mixed easily and intimately with the solvent; the high-melting-point wax present should have been crystallized from its solution in the oil slowly enough to permit good crystal formation; the temperature of the solvent should be the same as that of the crude wax slurry when it is mixed with it and this temperature should be low enough to prevent solution of any appreciable amount of the desired wax by the solvent; the amount of solvent used should be only as much as is necessary to reduce the viscosity of the resulting oil-solvent solution to the desired value and additional solvent used for washing or redispersing the recovered wax crystals should be at the same temperature as that to which the original crude wax slurry was cooled.

Regulation of Chilling Rates

During the course of numerous laboratory experiments, from which these indicated conclusions were drawn, it soon became evident that the crystalline structure of the wax separating from the oil during the production of the slurries was of prime importance. If the rate of cooling of the crude wax was chosen properly, the diluted slurry filtered readily and the wax cake formed could be easily washed free of oil by additional solvent. Properly cooled slurries gave wax cakes of small volume which were not appreciably compressible under the differential filter pressures employed. Hence, they did not develop cracks and straight displacement washing was secured which resulted in the production of

(Continued on Page 137)

Automatic machinery for packaging refined waxes at Union Oil Co. plant

Wartime Maintenance and Repair

Use of substitutes where formerly only special materials were thought permissible are widespread; asphalt emulsions instead of metal insulation covers; old header plugs built up and machined to size and other tricks are discussed here. These practices have been developed by Standard Oil Co. (Ind.) engineers

THE old saying "necessity is the mother of invention" was perhaps never better demonstrated than it has been in the methods and devices adopted to solve repair and maintenance problems in refineries in war time. It was not easy at first for engineers and maintenance crews to realize that they were going to be short on materials, that they could not obtain whatever they wanted by filling in a requisition blank or visiting the nearest supply stores. When shortages of critical parts at first appeared, maintenance men could have said, "Then it can't be done. We can't do the job." However, because of close cooperation among maintenance men, engineers, and executives, old mother necessity began to produce. Inventions and methods —not often seen before in the field of maintenance—began showing up.

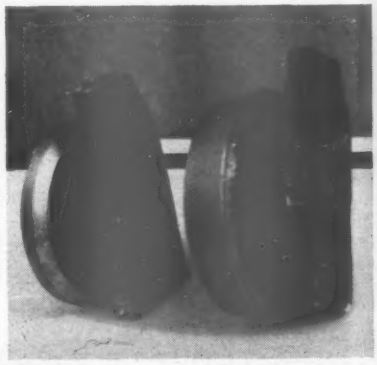
By substituting readily available materials, by introducing economies that would not ordinarily be thought worth while, by collecting and reworking used materials, by changing the uses to which materials were put, and by reinforcing, repairing and reusing parts which would ordinarily be thrown away it was discovered that something approaching marvels could be accomplished toward "doing more with less."

Men on Job Make Suggestions

At least this has been the experience in several of the refineries operated by Standard Oil Co. (Indiana). Most of the inventions and discoveries, the alterations in usual practices, the savings in materials have been made by the men on the job. Faced with the necessity of making old parts and materials fit the problem or letting some important unit shut down, they have ingeniously come up with an answer. Occasionally executives and engineers have had to lend assistance by suggesting some way to solve the problem or by suggesting a new attack. But in general much has been accomplished in meeting the ever more difficult problems of maintenance by the aggregate of good ideas developed as workers have wrestled with breakdowns, threatened breakdowns, or malfunctioning of equipment.

A long list of specific examples could be cited. No one of them would seem to be astounding in newness or importance. But in sum total they would spell the difference between serious difficulties and continued operation at or near capacity. A few examples will indicate how Standard of Indiana's refinery-maintenance crews have met the problem of shortage of materials and how their experience can be applied in other plants. If there ever was a time when the knowledge gained by one company should be passed on freely to others it is now when the petroleum industry must strain every facility to make the products so urgently needed to superpower America's mechanized war against the Axis forces.

A long-accepted method of protecting insulation on refinery drums and vessels has been to surround it with a jacket of galvanized iron. This practice has now been abandoned and an asphalt emulsion containing ground asbestos is being used as insulation protection. For similar protection of insulation on steam lines a commercial product offered by one of the most prominent manufacturers of insulation materials is used. Standard's Wood River, Ill., maintenance men have been successful in using asbestos packing in place of rubber on a large number of pumps where rubber had been considered indispensable. Because the practice is necessary rather than because it is adequate they are making guard posts to protect stanchions, valves, and other installations in the refinery from scrap lumber instead of



These photographs show steps employed in the process of rebuilding header plugs, from cutting down diameter, building up with flange steel scrap to oversize, and cutting to exact dimensions. Picture at right shows a plug cut to smaller size, left, and after fitting "cover," right. The two cuts below show vertical and horizontal views of cover plates, left; cutdown old plug, and rebuilt plug machined to exact size, right

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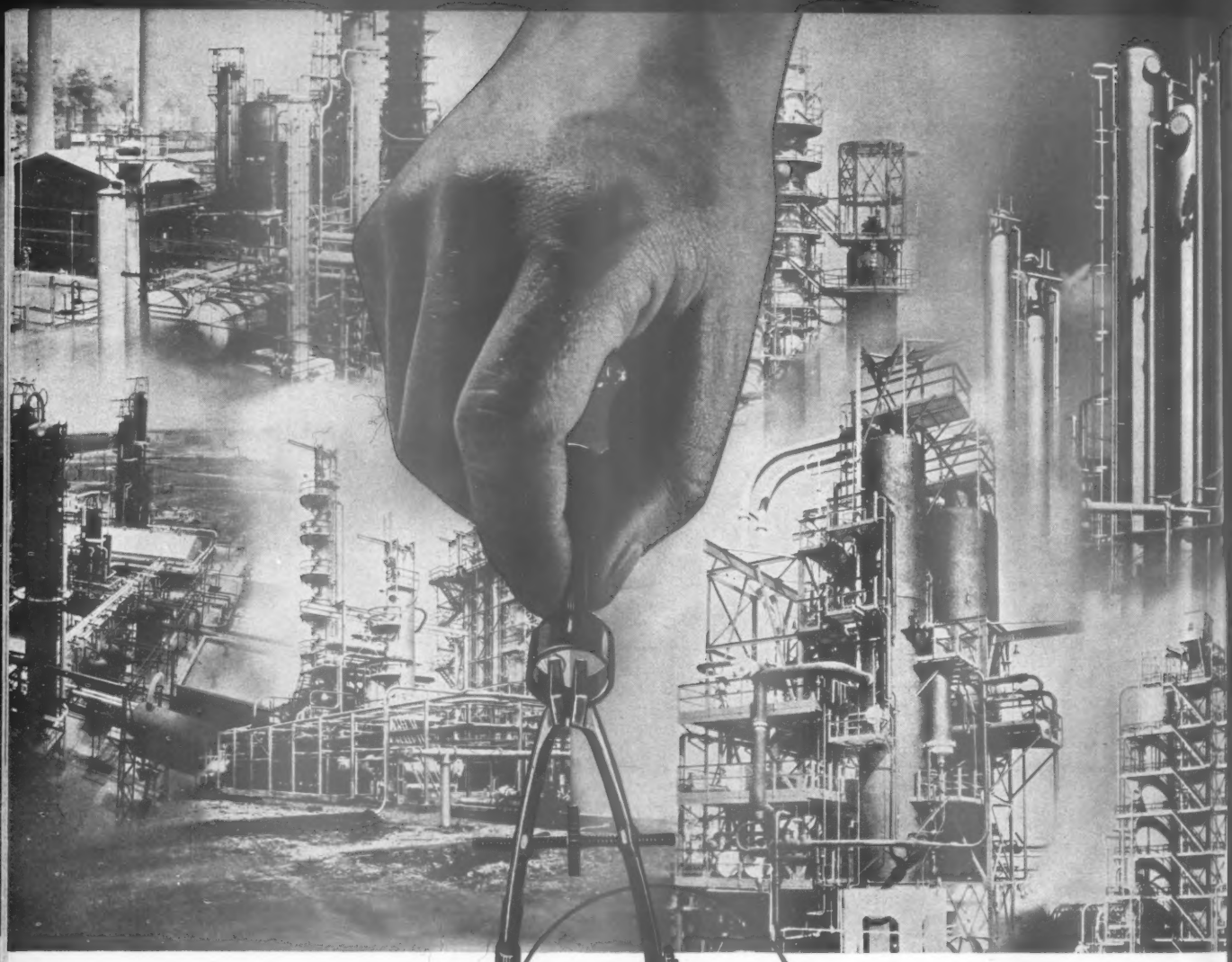

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from steel as they formerly did.

The problem cannot always be solved by utilizing a noncritical material—sometimes the answer is to substitute a less-critical material for the most critical. For example, repair parts for valve links, bushings, and crossheads on various pumps and compressors were formerly made from brass. They are now made from cast iron, which can usually be obtained, and Parker valve studs which were formerly made from brass are made from steel.

Repair crews at the Whiting, Ind., refinery have found it impossible to secure replacements for the chrome alloys used in pump shafts. They now use case-hardened steel substitutes. Casper, Wyo., refinery crews have been reclaiming monel metal screens by sandblasting and soldering. When new steel cannot be obtained to patch and replace coking still bottoms they are successfully using scrap tank steel in its place. In fact, scrap materials are being promoted extensively to positions of responsibility for which they would not have been considered in normal times.

It is inevitable under current circumstances that past standards shall be sacrificed to some degree to necessities. The construction crews at Whiting in their work of the last year have found numerous places where they can get along without the use of reinforcing rods in laying concrete even though these were jobs where introduction of rods would have been practically automatic under normal circumstances.

In orifice meters it has been customary to seal the instruments in glycerin. Glycerin is, of course, critically needed for manufacture of explosives and not now available for many of its previous uses. By exercise of a little ingenuity it has been found that water can usually be used in its place where instruments possibly can be protected against freezing.

Repairing Corroded Header Plugs

At the Neodesha, Kans., refinery an interesting method has been developed to repair corroded header plugs in cracking still furnaces. This is described by E. A. Metcalf, manager, as follows:

"Our units have the conventional box-type tube headers. The header plugs are made of carbon steel and vary in thickness from 1⅞ in. to 1¼ in., depending on the size of tube.

"The plugs have shown progressive corrosion from the time of installation. During the fall of 1942 some of the plugs had corroded to a thickness of ¾ in. and it was necessary either to purchase new plugs or repair the old ones. Due to the scarcity of critical materials it was decided to attempt a satisfactory method of repairing the plugs.

"The corroded plug is machined to a diameter approximately ⅞ in. less than its original diameter; and to a thickness of approximately ¾ in. The front and side portions of the machined plugs is then 'covered' with a ½-inch flange steel plate, thus making the rough, covered plug ⅛ in. larger diameter and the same thickness as the original plug. The 'covering' process is performed as follows: First, a steel die is made having an inside diameter ⅛ in. larger than the desired outside diameter of the finished plug and the same depth as the finished plug. The 'cover plate' is cut to the necessary shape so no waste will result when the plate enfolds the old machined plug. The cover plate is then heated in the furnace, placed on the die while hot, the old plug placed on the plate and driven home with the steam hammer The covered plugs are very quickly and efficiently made after the work is completely organized. The upper edge of the cover plate is then welded (one bead) to the old plug. The covered plug is then machined to the proper diameter. The machining cut varies from 1/32 in. to 1/16 in. in thickness. Scrap material is used for making the cover plates.

"Aside from using scrap materials for this work, we find that the repaired plug costs considerably less than a new plug and serves our purpose just as well as a new one.

"Accompanying photographs illustrate the materials and methods used in the work and also show a finished plug."

Repair Displaces Replacement

The Whiting refinery has found numerous ways to extend the life of mechanical devices instead of replacing them. Steel valves and pump plugs which have worn down to minimum thickness are now built up by welding followed by remachining. Similarly, babbitted machine bearings have been repaired by sweating on small quantities of babbitt at the low spots and remachining. Under ordinary circumstances the repair would consist of complete rebabbitting of the bearings. Pumps worn out at the liquid ends are rehabilitated by boring them out and installing liners. Sugar Creek, Mo., has contributed a thought along this same line by reporting that instead of replacing worn bronze bearings the workers now shim on the outside of them and remachine the bore so that they can be used for a longer time.

Without going into extensive details it may be mentioned that studs and bolts up to 1¼ in. in diameter are being made from old reinforcing rod and other scrap steel. Whiting has also been making holding-down bars for bubble caps, where alloy steel is required, by slitting and flattening small sizes of scrap-alloy tubing.

When plenty of new materials were available and the price for scrap metals was only moderately attractive, demolition of old equipment proceeded very slowly. Last year, on the contrary, every possible effort was made to dismantle unused equipment to extract from it needed materials and to send to the blast furnaces the parts and pieces good only for melting. In this process many thousands of feet of buried pipe lines have been dug up and either stacked neatly in salvage piles or put into new uses at once in other locations. The same holds true of course with respect to fittings. In the past dismantled equipment was frequently sold in whatever shape it could be made movable—exchangers may be taken as an example. These are now dismantled so that the tubing or plate they contain can be used again. Another minor but worthwhile practice has been adopted at the refinery at Casper. Pipe-wrench jaws formerly went to the scrap pile as soon as they become worn or damaged to the extent that they would no longer bite satisfactorily. These wrench jaws are now returned to the factory for reconditioning, and for 50 per cent of the cost of new jaws entirely satisfactory remade wrenches are obtained.

Less-Exacting Demands

Whiting refinery people have found that many of their old materials though no longer suitable for previous duties can be used where the demands upon them are less exacting. For instance, tubing which has reached the minimum effectiveness permissible for preheating service can be used elsewhere in place of ordinary pipe. Likewise, pipe which has become too thin for operations involving considerable pressures can be removed and used where lower pressures are employed. Such measures would hardly be thought of in ordinary times but they are a great help in making necessary alterations in equipment possible in these times when new pipe cannot readily be obtained.

Manager W. J. McGill reports from the refinery at Wood River that his repair crews have effected substantial savings of new materials by carefully collecting and reclaiming nails, bolts, nuts, railroad spikes and many other such small items. They even save wire from incoming crates and boxes. This practice requires some additional and unusual labor of course, but it increases the refinery's store of items and metals which cannot be readily replaced.

In addition to the substitutions, the alterations, and the repairs much can be done to lengthen the life of equipment and facilities by greater intensity in the practice of ordinary or even perhaps obvious economies. For instance, a concerted drive to effect economies in usage of steam hose enabled the Wood River refinery to get along in the last half of 1942 with

about 25 per cent of the consumption which would previously have been considered normal. An educational campaign was put on to cause operators and others using steam hose to use greater care in handling it. Whenever it now is necessary to supply steam for maintenance or emergency purposes, even for short periods, a temporary steel line is installed. Previous practice was to use rubber hose. Installation of steel lines of course require more labor but considering the unavailability of rubber at present this additional labor cost seemed justified. At any rate the method has resulted in much less wear and tear on steam hose. The steel pipe suffers little or not at all from the emergency uses and can always be taken out and moved to another location when needed.

The Whiting refinery has an additional angle to the practice of substituting steel pipes; ordinary rubber hose has been replaced in several locations for the purpose of tower washing. Whiting has also discovered that the life of steam hose can be extended by joining short lengths together instead of discarding them.

Consumption of rope was decreased by 35 to 50 per cent by carefully sorting all rope and allotting it to suitable uses. Old rope was used for light work where it would be under no great strain while new rope was reserved for the heavy lifting jobs.

Economy in Lighting

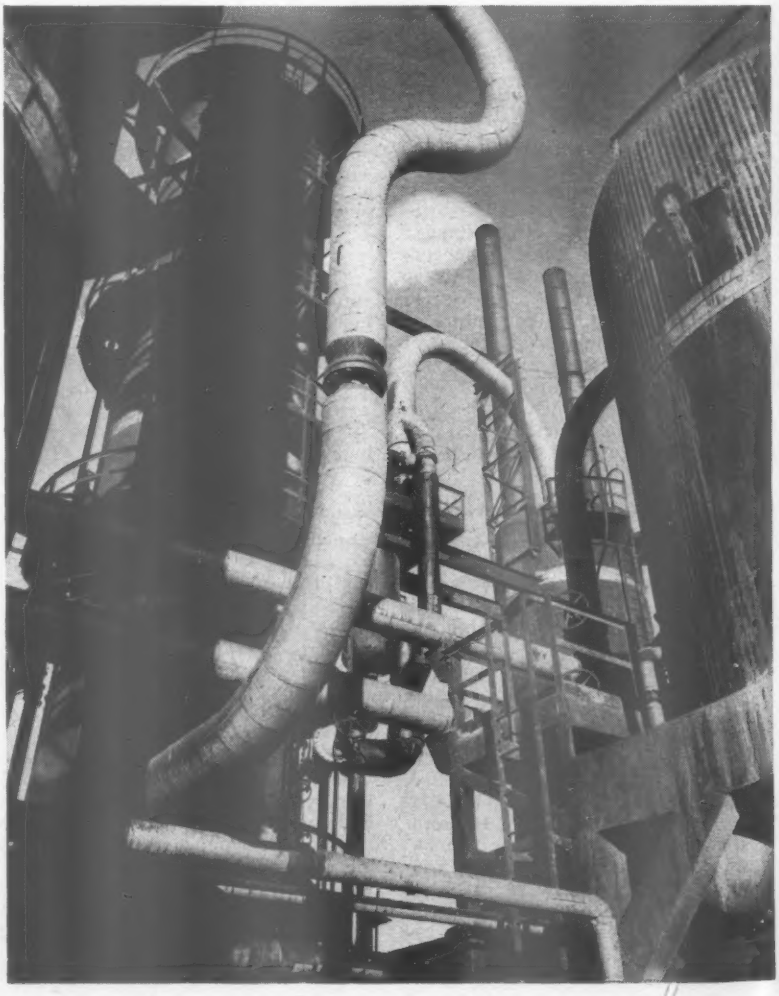
Wood River has also sent in some good suggestions regarding economy in lighting and equipment pertaining thereto. In accordance with the good safety practices emphasized in a refinery which recently established a new world's record for number of man hours worked without accident, it has been the practice to protect open trenches and ditches anywhere in the works with temporary strings of red lights. This is an obviously good practice, but one which can be dispensed with in the present emergency where sufficient yard lighting is available. The Wood River workers have substituted wooden barricades painted black and white or black and yellow wherever the usual night lighting will satisfactorily illuminate them, and such conditions have been found in nearly every instance so far arising. The practice is economical. It has resulted in considerable saving of electric wire, since the earlier method was especially hard on insulated wire. Consumption of electric bulbs has also been reduced by selecting certain light circuits not normally needed at night and marking the controlling switches with numbers and color scheme to serve as reminders to employes that such circuits should be turned on only when in use and turned off immediately thereafter. It was found that a large number of lights were in this classification. Education and markings together have made it possible to accomplish a substantial reduction in lamp usage without in any way affecting the safety of night operations.

Industrial-Gas Cylinders

At the Sugar Creek refinery it was found that it would be impossible to obtain as many cylinders as had previously been employed as containers for industrial gases. The necessary economy was obtained without loss of efficiency in operation by developing a system of more frequent fillings and deliveries of cylinders. Fewer cylinders were left on each delivery but they were more frequently replaced.

It has not been possible as yet to determine with any assurance of accuracy whether the net result of the many devices to which maintenance crews have resorted is an actual saving in cost or not. Certainly first costs in materials have been cut by the extension of use of old materials. However, that there have been additional labor costs in remaking and adapting these old materials is equally certain but as to just how these two factors and all others which may be involved balance out it would be difficult to say without a more extensive study than has preceded the writing of this article. At least it has been clearly demonstrated that today's necessities can be met by using a little thought and inventiveness to devise new materials, new methods, and new ways of utilizing the old. So far the wartime expedients have at least kept the refineries going and it is to be hoped that they will continue to do so until the time when steel and other critical materials will be as freely available to industry as they must at present be to the armed forces.

Cracking units such as shown here require more maintenance than most other refinery equipment, because of the severe operating conditions employed



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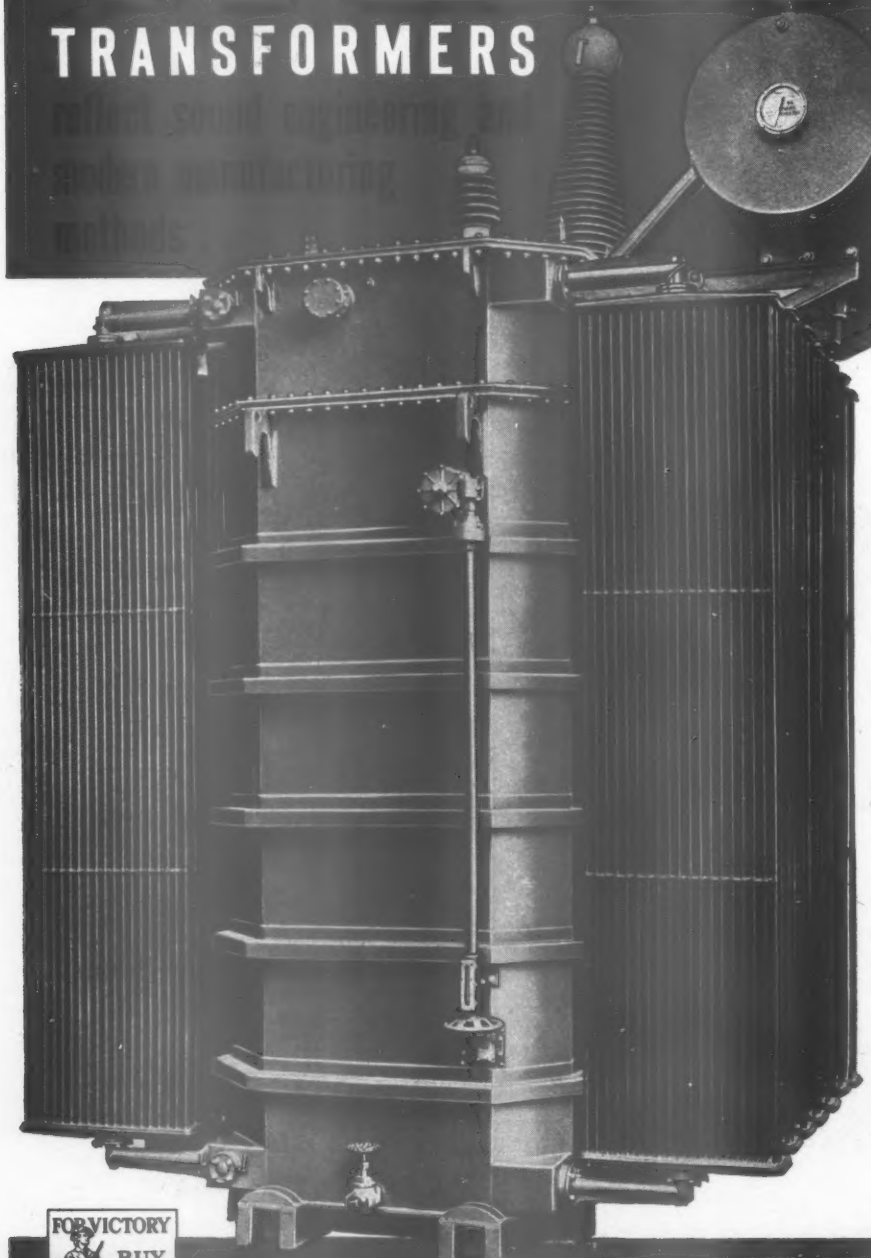

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ELECTRICAL AND AUTOMOTIVE PRODUCTS

Combustion of Excess Gas

by R. A. Fox*

Automatic control of boiler firing becomes more imperative under the excessively varying loads applied by modern refining operations. Disposal of excess refinery gases without waste also is often a serious problem. This article shows how new methods may be applied.

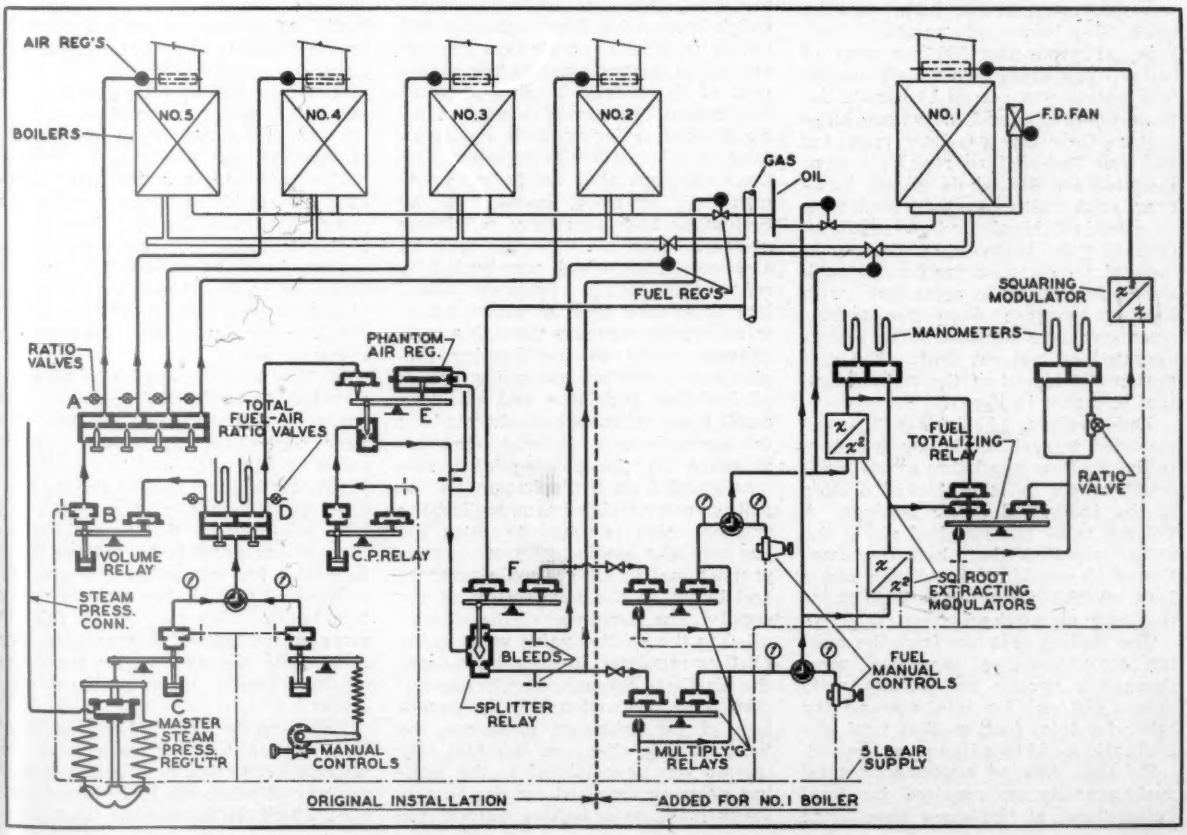
THE increasing utilization of what were formerly refinery waste gases, for manufacture of valuable byproducts, is throwing an ever-more-difficult burden upon that much neglected auxiliary to successful refinery operation—the boiler plant. The boiler plant has always been to a greater or less extent, the red-headed stepchild of the refinery—expected to produce steam and power in satisfactory quantity and quality, regardless of the erratic nature of the loads; condemned to use as fuel only what could not be sold or used elsewhere in the refinery; and often to do both of these with insufficient reserve margin of capacity to take care of breakdowns or emergencies.

With the advent of alkylation, isomerization, hydroforming and polymerization, the waste gases formerly plentiful are becoming more and more scarce and valuable. The scarcer they become, the greater is the variation in the degree of their availability for fuel, and hence the more difficult the problem of using them efficiently as boiler fuel. This problem promises to grow in complexity and difficulty, rather than decrease. A history of how it has been taken care of in the plant of Globe Oil & Refining Co., at Lemont, Ill., illustrates how the application of automatic combustion control has helped in solving it for this plant.

The problem of boiler-plant operation was the familiar one of insufficient boiler capacity so that it was necessary to operate the boilers at almost maximum rating practically all of the time. Load swings of approximately 60 per cent of rating occurred but these were not as bothersome to manual operation as were the wide and violent fluctuations in gas supply and gas pressure. It was, of course, desired to use gas to the fullest extent possible but at times no gas was available and the swing from entirely sufficient gas to no gas might occur several times in a shift. This condition just could not be handled by manual control. Therefore, the decision was arrived at to attempt

*Chief Engineer, Globe Oil & Refining Co.

Fig. 1—Combustion control diagram of Republic system of automatic control employed on boilers Nos. 2 to 5



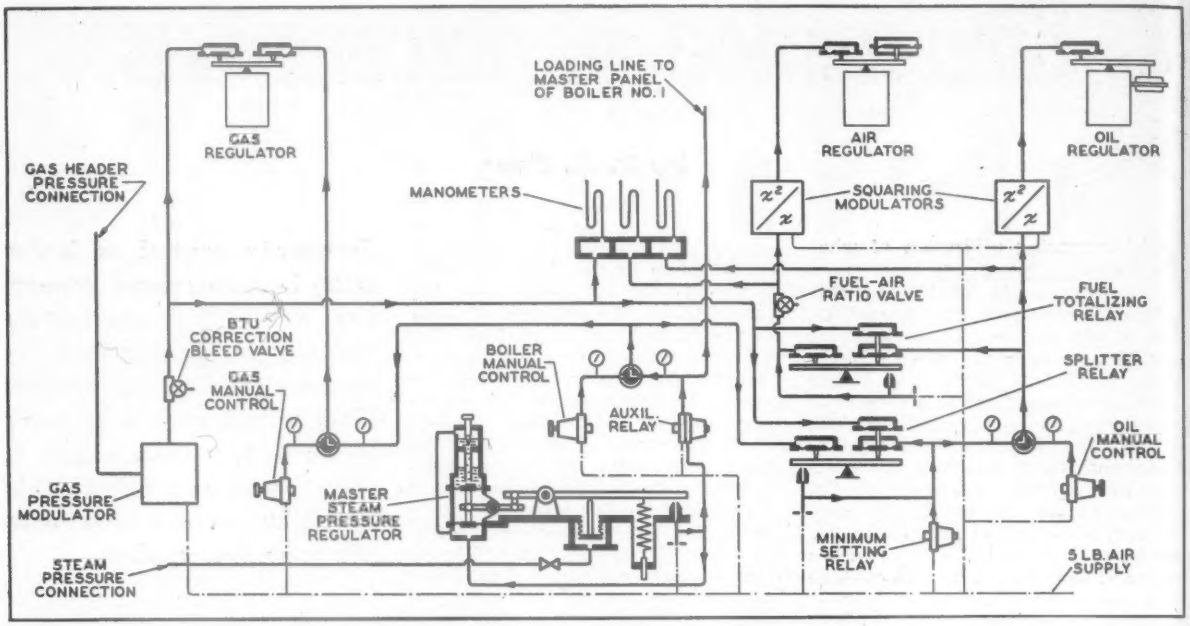


Fig. 2—Diagram of the same system control used on parallel boilers Nos. 1 and 6

to solve it by the use of automatic combustion control.

Details of Control System

The original boiler installation consisted of three boilers, to which a fourth was added a little later. These were all rated at 500 b.hp. capable, since they were of natural draft type, of producing 200 per cent of rating. The original combustion-control system was set up to handle the three boilers (later four) as one large boiler. Only one gas-flow regulator and one fuel-oil-flow regulator were installed for the whole group. However, each boiler was provided with its own individual air-flow regulator operating the boiler-outlet damper to maintain combustion gas flow through the boiler setting in accordance with loading pressure from the master steam-pressure regulator. The boilers operated on natural draft. The diagrammatic layout of the control system is shown in Fig. 1.

Ratio valves, (A) in Fig. 1, were provided in each of the loading lines to the air-flow regulators so that each could be set to take care of fouling of the individual boiler settings. A volume relay (B) supplied air to the ratio valves so that their consumption of air would not impose an undue load on the master steam-pressure-regulator air mechanism.

The loading pressure from the master steam-pressure regulator went through a similar set of two ratio valves (D) one for total air and the other for total fuel, so that total air-fuel ratio could be adjusted as desired.

To take care of maintaining total fuel quantity as required by total boiler load, at the same time using gas for fuel when it was available and supplementing or replacing it with oil only as necessary, a phantom air circuit was introduced into the fuel side of the loading air system. The loading air pressure from the combustion air side of the fuel-air-ratio adjuster was imposed on the weigh beam of a flow regulator (E), which established an air flow through an orifice proportional to the square root of the master loading pressure. To prevent changes in density of the air from interfering with the accuracy of this ratio, the phantom system was operated at 20-in. water maximum pressure, instead of the customary 10-in. mercury maximum pressure. This air flow was split by a splitter relay, which was loaded by refinery-gas-supply pressure. Each line from the splitter relay transmitted its air pressure through a multiplying relay to the loading diaphragm on the corresponding gas or oil-fuel-flow regulator, and also to a small fixed orifice where the air bled to atmosphere. Likewise, the air pressure on the gas-regulator side was exerted on a diaphragm on the splitter-relay weigh beam, so that the splitter valve operated to keep the gas-regulator loading pressure always proportional to the gas-main pressure and hence to the availability of gas supply. The remainder of the air supplied to the splitter valve went to the oil-flow-regulator loading line. Since the air flows through the bleeder orifices were proportional to the square root of the upstream pressures, the total loading effect on the fuel regulators was proportional to the loading pressure imposed by the master steam-pressure regulator (C) on the loading diaphragm of the phantom air-flow regulator (E), and hence to total fuel requirement. The multiplying relays converted the low pressure of the phantom system into the standard 0-10-in. maximum pressure for loading the fuel-flow regulators.

This system operated quite satisfactorily for some time, but proved rather difficult due to several causes. The phantom system could not be made sufficiently fast in action, and at the same time stable in operation, to keep up with occasional rapid and violent changes in gas availability. It was difficult to obtain sufficiently accurate setting of the bleeder valves on the splitter-relay loading lines to the fuel regulators. Operators found the system hard to understand, and at times of upsets were too prone to change over to manual control, which resulted in inefficient use of the available gas.

In 1940 a new boiler was added—now known as No. 1. This boiler was equipped with a forced-draft fan with vane control of air volume. It is rated at 600 b.hp. and is capable of producing 350 per cent of rating. Separate gas-flow and oil-flow regulators were provided for this new boiler, so that it was possible to balance total fuel flow for this boiler independent of the fuel and air flows to the other four boilers. Since all boilers fed the same steam header, it was necessary to operate the new boiler from the original master steam-pressure regulator.

Between the time when the original installation was made and the installation of this new boiler, a new method of totalizing had been developed which did not depend upon man-

ual adjustment of bleeder valves, and this was used to totalize the oil and gas fuels and provide the total air required for both fuels, while still depending on the original splitter relay to determine the proportion of oil to gas fuel in accordance with the gas availability.

Multiplying relays were installed to convert the inches of water pressure in the splitter-relay-outlet lines into inches of mercury loading pressure for the totalizing relay system.

Splitter-Relay System

Since the fuel flows are proportional to the square roots of the pressure drops across their respective orifices, it is necessary to extract the square roots of the individual values, or some equivalent of them, add these extracted values, and then reconvert this sum into a squared value, since the air flow also is proportional to the square root of the combustion-gas pressure drop through the boiler. This is accomplished by imposing the loading pressures going to the fuel-flow regulators on square-root-extracting modulators, or relays, adding the two by means of a totalizing relay, squaring the result in a squaring modulator, or relay, and imposing the resultant loading pressure on the loading diaphragm of the air-flow regulator, which operated the stack damper.*

Since forced draft was provided for this boiler, a forced-draft regulator was installed, which operated the inlet vanes on the fan to maintain furnace draft constant.

This setup, of course, did not eliminate the defects present in the splitter-relay system. In addition, it was desired to be able to operate either the new boiler—No. 1—or the old boilers—Nos. 2 to 5, on constant high rating, causing the other or others to take care of changes in steam demand, and still proportion the gas and oil firing as required to burn all the available gas. Since the method of using all the available gas was intimately interconnected with the master steam-pressure regulating system, through the operation of the original phantom air circuit, the aim of operating part of the boilers on constant high rating could not be realized.

In June 1941 a new boiler, known as No. 6, was purchased. This is the same size as No. 1, namely 600 b.hp., and is able to operate at 350 per cent of rating. The control setup for this new boiler was arranged so that it could be operated either on pressure control or constant-rating control and burn all available gas with either setup. The hookup provided for taking care of gas as it was available functioned much more satisfactorily than that of the original installation, so an attempt was made to operate Nos. 1 to 5 boilers on constant rating, but this did not function satisfactorily for several reasons. The swings in load were too great to be handled by No. 6 boiler alone; the gas pressure, due to changes in refinery operations, was unusually high, which caused critical-pressure drop across burner orifices at high ratings and also due to the changes in refinery operations, the heat content of the gas fluctuated widely.

It was therefore decided to operate the old boilers—Nos. 2 to 5—on constant rating on oil fuel, and to operate Nos. 1 and 6 and in parallel on automatic control to take care of load fluctuations.

The control layout for boilers Nos. 1 and 6, as finally installed, is shown in Fig. 2. The cam of the gas-pressure modulator is cut so that the modulator-output pressure is always a direct function of the flow, regardless of whether the pressure is above or below the critical value. (When the upstream pressure on an orifice exceeds roughly 1.8 the downstream pressure, the flow through the orifice is directly proportional to the pressure drop; when the upstream pressure is less than 1.8 times the downstream pressure, the flow is proportional to the square root of the pressure drop.)

The output pressure from the gas-pressure modulator is imposed on three separate devices: (1) the gas regulator, (2) the splitter relay and (3) the fuel totalizer.

Handling Low Gas Supply

When the gas supply becomes inadequate to take care of demand, the gas pressure on the splitter relay will become inadequate to balance the master loading pressure. The output pressure from the splitter relay is imposed on a squaring modulator, the output pressure of which goes to the oil-flow regulator. In this manner the oil flow is made directly proportional to the output pressure of the splitter relay. Variations in gas-supply pressure cause immediate changes in splitter-relay-output pressure, so that the oil flow is immediately changed to keep the total heat supply to the value called for by the master steam-pressure regulator.

When the gas supply is more than sufficient for all the heat needed in excess of that provided by the minimum fuel-oil flow, the gas regulator acts to maintain the gas-pressure modulator-output pressure at whatever value is set by the master steam-pressure regulator, which governs the pressure imposed upon the other diaphragm.

In order to permit the maintenance of a minimum fuel-oil flow, the minimum relay prevents the splitter-relay-output pressure from ever dropping below a set desired value. On this account the master steam-pressure regulator-output pressure cannot be used directly as the measure of the air requirement at all loads, but it becomes necessary to totalize the actual fuel consumed. This is accomplished by the fuel totalizer, which adds the outputs of the gas-pressure modulator and the splitter relay. The resultant pressure is transmitted to a squaring modulator, so that air flow is then proportional to total fuel.

B.t.u. Correction Valve

To permit taking account of variations in heating value of the gas fuel, the B.t.u. correction valve is installed in the gas-pressure modulator-output line. This is a manual adjustment, by means of which the operators may adjust the air flow to correspond to the B.t.u. content of the gas.

This system of control has been in quite successful operation for approximately 6 months. The requirements of simultaneously maintaining satisfactory steam pressure in spite of a widely fluctuating load and of burning gas as available in the maximum possible amount, while supplementing it as necessary with fuel oil, have been fulfilled in an entirely satisfactory manner. As the supplies of refinery gases available for fuel diminish and become more erratic in availability, such a boiler-control system, or one similar to it and fulfilling the same functions, will become a necessity in every refinery boiler plant.

*Description of the operation of these modulators will be gladly sent upon request. (The Author.)

New England Fuel-Oil Sales 76 Per Cent Normal

WASHINGTON, D. C.—Heating-oil sales in New England by the 13 principal supplying companies amounted to 75.9 per cent of normal during the 4-month period, October through January, it was announced last week by the PAW.

Sales figures by months, compared with normal, are as follows:

	Barrels		% 1942-43 to normal
	Normal	1942-43	
October	2,638,536	2,029,654	76.9
November	4,081,934	3,029,757	74.2
December	5,804,933	4,765,263	82.1
January	6,063,035	4,280,032	70.6
Total	18,588,438	14,104,706	75.9

Standard of California Gives $85,000 to Red Cross

Describing the needs of the American Red Cross as greater than ever before, H. D. Collier, president of the Standard Oil Co. of California, announced an $85,000 contribution to the Red Cross drive in the seven western states, Alaska and the Hawaiian Islands.

★ ★ ★ A New Pneumatic T

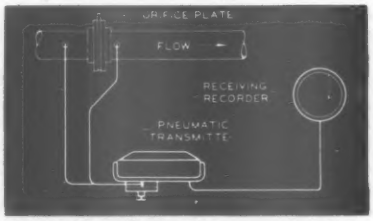
FOR MEASURING FLOW AND LEVEL

Operating on the Force-Balance Principle

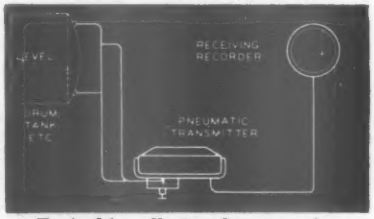
The Republic Differential Pressure Transmitter is an entirely new type of pneumatic meter which has been thoroughly field tested during the past two years. It is a simple pneumatic device for converting a differential pressure, such as is produced by the flow of a fluid through an orifice or by liquid level in a vessel, into an air pressure which varies proportionately with the differential pressure.

This air pressure is used as a direct measure of the differential pressure and can be conducted to a remote location by means of tubing. A gage or receiver connected anywhere in this transmission line will show the variations in the differential pressure and may be graduated in terms of the flow or level which it represents. The pressure can also be utilized as the impulse for actuating a controller.

The Republic Pneumatic Transmitter operates exactly like a weigh scale. The force of the differential pressure on a measuring diaphragm is the value being weighed. This force, multiplied by its lever length, is balanced by the force on a reaction diaphragm times its lever length. The pressure on the reaction diaphragm represents the weights used on a scale and is merely a means of automatically accomplishing this weighing process and transmitting the results.



Typical installation for measuring flow.



Typical installation for measuring liquid level.

RANGES—standard ranges are available from 0.9 in. to 25 in. of water differential, for working pressures up to 15 psi.; 7 in. to 50 in. of water for working pressures up to 25 psi.; and 13 in. to 800 in. of water for working pressures up to 600 psi. Special heads can be provided for working pressures up to 2000 psi.

RANGE EASILY CHANGED—the range of a Republic transmitter can be readily changed by making a few minor adjustments or substituting a few simple parts. For example, a transmitter with a differential range of 50 in. of water can be changed to any range up to 100 in. of water by merely changing the position of the reaction diaphragm.

DIAPHRAGM MATERIAL—diaphragms for the Republic transmitter can be made from practically any material including rubber, synthetic rubber, Saran, brass, stainless steel, Monel, silver, etc. This is possible due to the extremely small motion required. (.010 in. for full scale reading). The material is specified in accordance with the solvent or corrosive action of the measured fluid.

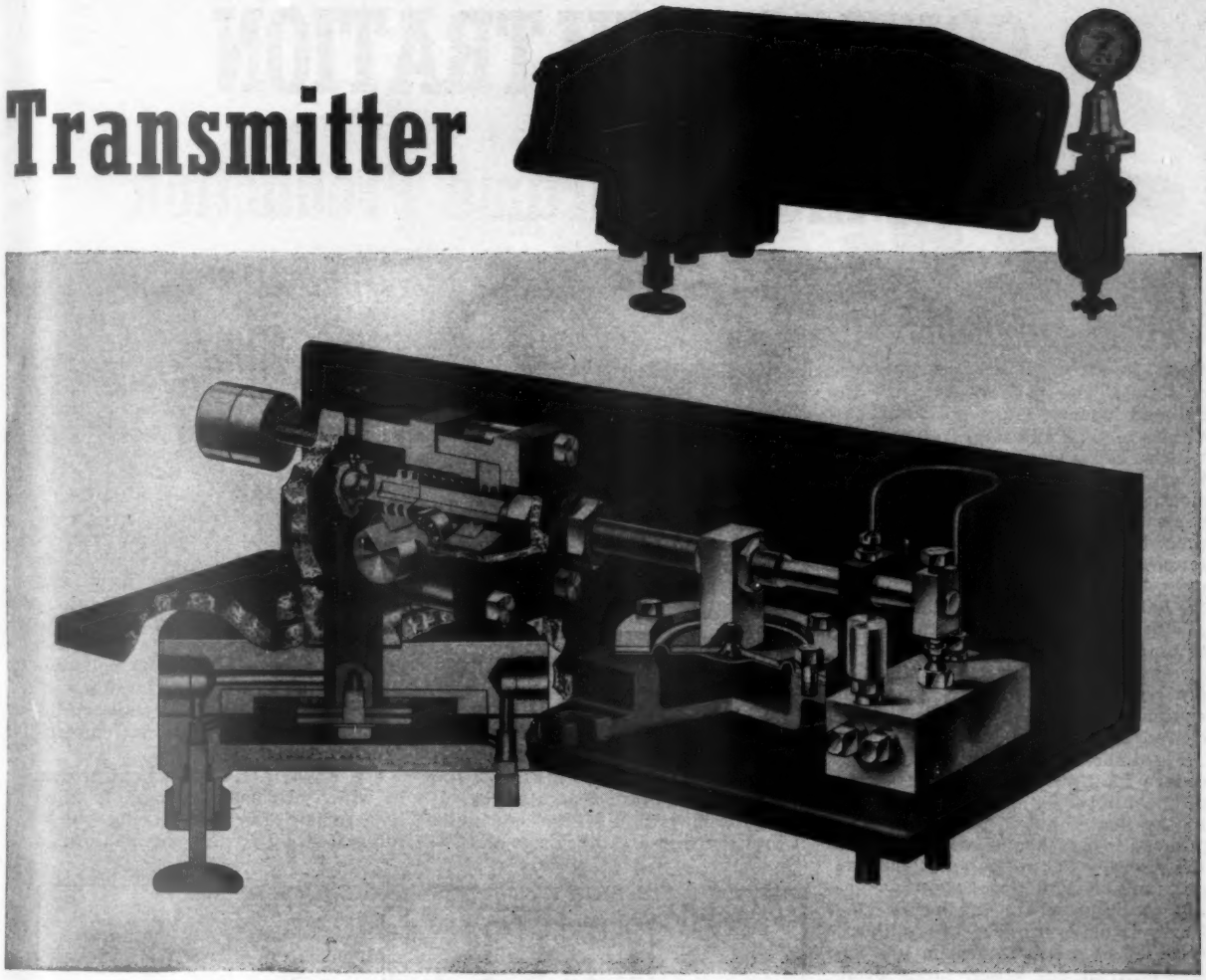
●

For complete details write for Bulletin No. 43-4

REPUBLIC

2212 DIVERSEY P

Transmitter



Exterior and cut-away view of the Republic Pneumatic Transmitter.

PERFORMANCE FEATURES

ACCURACY of the Republic force-balance method of measurement is higher than can be consistently secured and maintained with any other method. Transmitting pressure vs measured differential is guaranteed within ½ of 1% of meter range.

SENSITIVITY — due to the negligible motions required for complete operation of all parts for full scale change, no appreciable hysteresis results from reversal of direction of measurement change. The hysteresis loop is so small that it is undetectable by ordinary means, being less than 1/20 of 1%.

RESPONSIVENESS — due to the fact that there is virtually no volume displacement, the Republic Pneumatic Transmitter is able to follow flow changes almost instantaneously. The time required to produce full output pressure at the transmitter is in the nature of fractions of a second, after the differential is imposed. Therefore a receiving instrument installed adjacent to the transmitter will show flow changes almost instantly. With 500 feet of ¼ in. O. D. tubing, the full value of the change will have registered on a Republic receiver in 15 seconds. This is the overall lag in the system not merely the transmission lag.

NO TEMPERATURE EFFECT — the effect of ambient temperature variations on the accuracy of a Republic transmitter is negligible. Since all parts are equally effected by temperature changes, force and leverage relationships are not disturbed and accuracy is unimpaired.

NO VIBRATION EFFECT — the Republic transmitter is unaffected by any normal frequency of vibration ordinarily encountered in industrial or process plants.

AIR CONSUMPTION — the air consumption of the pneumatic system is .20 cfm. maximum at 20 psi. supply pressure, when differential is zero. At maximum differential consumption is zero and is inversely proportionate to intermediate, differentials.

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CONTACT FILTRATION

—as an Aid to Wartime Production

by R. C. Davidson *

Filtration of non-critical products and often of critical materials now is a matter of making what we have do the job required. Here are eight separate flow charts and the methods employed with them to utilize existing equipment most profitably.

THE fundamentals of contacting are simple. The oil and adsorbent are agitated together under optimum conditions of time and temperature after which they are separated by filtration, the filtrate cooled and sent to storage or subjected to further treatment. Owing to the simplicity of this procedure there are a number of different systems which may be employed commercially for carrying out the essential operations. This multiplicity of design provides contact filtration with its greatest utility during an emergency, for it means that the process is adaptable to whatever equipment is available or can be purchased second-hand.

Fig. 1 shows the recommended procedure for finishing motor oils. Most of the raw stock is charged directly to the heater but a portion of it is pumped to a preheater, which reduces the viscosity of the oil, and then to a mix tank beneath a continuous weighing machine where the heavy clay slurry is made up. The heavy slurry is added to the main stream just before entering the heater tubes. From the heater the oil-clay mixture is transferred to a stripping tower in which volatile impurities are stripped from the oil by a combination of both open steam and vacuum. This stripping tower is designed to allow for the desired contact time; and steam, and/or mechanical agitation is used to keep the clay in suspension. The slurry is pumped from the stripping tower through an exchanger or cooler to the continuous vacuum precoat filter. A vacuum maintained on the filtrate tank and on the inside of the rotating filter drum separates the oil from the clay in the filter and pulls it into the filtrate tank. From the filtrate tank the oil is sent through a cooler and to finished oil storage. This system is especially suited to automatic control and will operate satisfactorily with one man per shift.

For most cases the above arrangement is the ideal method of applying contact clays but it is by no means the only way in which they may be used and examples of some other schemes are diagrammed in Figs. 2 through 8. The main point where these flow diagrams differ from the ideal is in the matter of a filter—all of these systems show the substitution of a pressure filter for the vacuum precoat filter, since pressure filters, such as Sweetlands, are currently available second-hand.

Fig. 2 shows an intermittent process in which an insulated tank is filled to a certain level, clay being put in the system by passing the oil through

*Filtrol Corp.

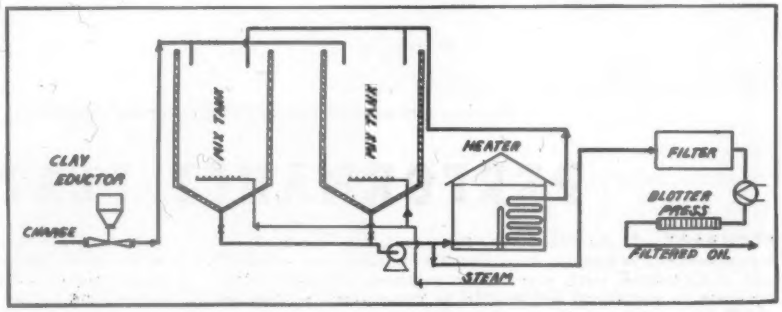

Fig. 2—Intermittent process in which an insulated tank is filled to a certain level, clay being put in the system by passing the oil through an eductor

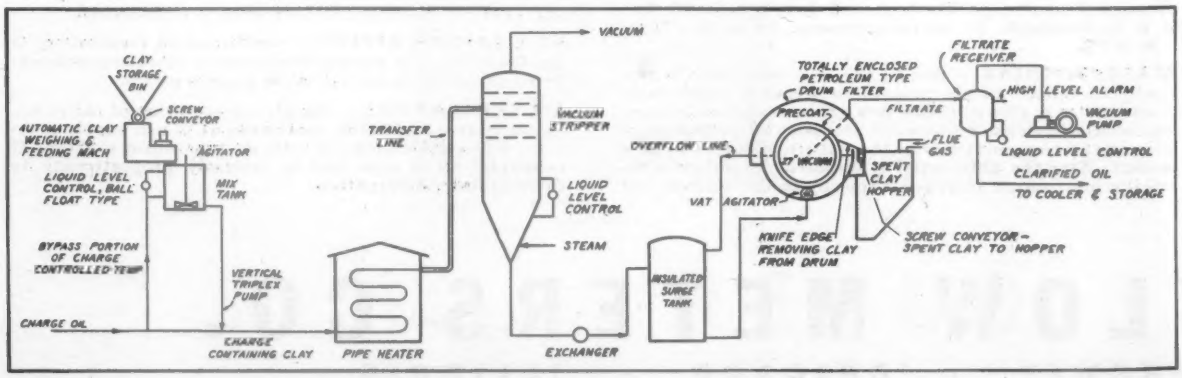

Fig. 1—Recommended procedure for finishing motor oils

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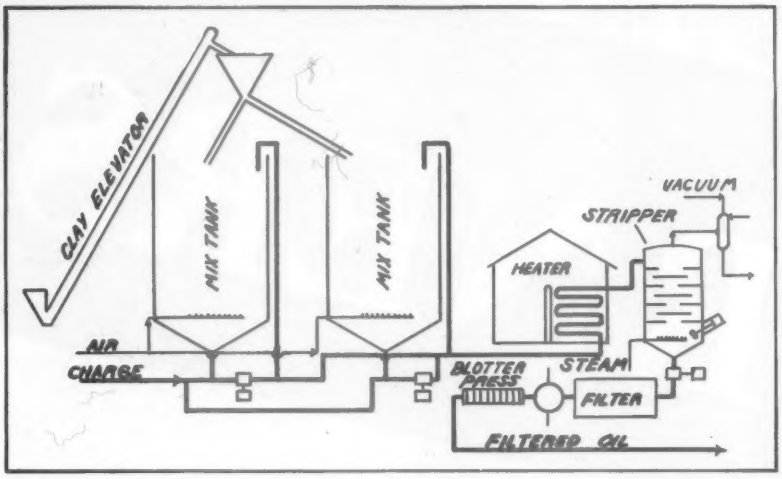

Fig. 3—Hot clay-oil mixture from heater does not return to the tank in which the slurry was mixed but goes to stripping tower and then to press, cooler and storage

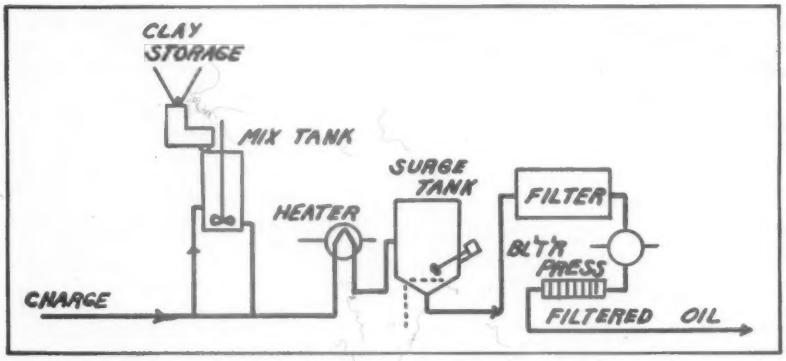

Fig. 4—System for continuous, moderate-temperature contacting

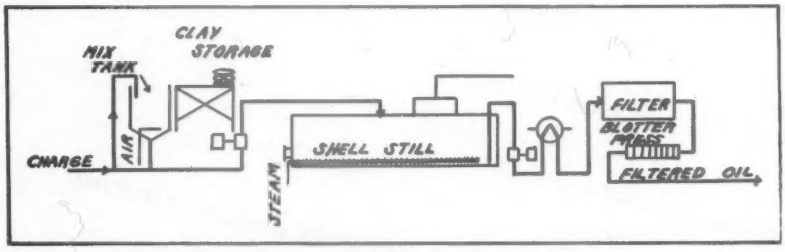

Fig. 5—Batch operation using a shell still

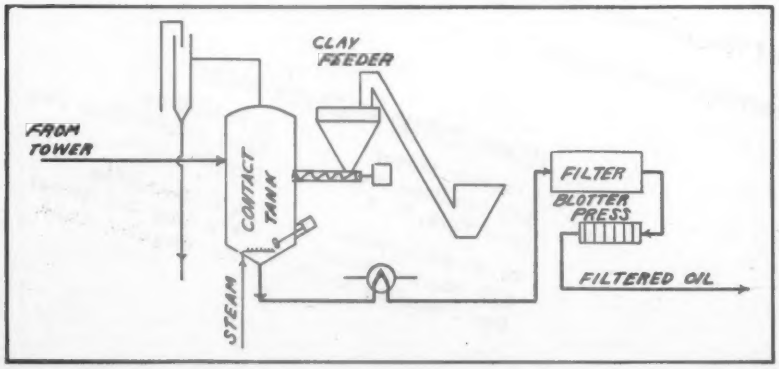

Fig. 6—Method of contacting for use in conjunction with a stripping operation

an eductor. When the desired quantity of material has been added, the oil and clay are circulated between a heater, or exchanger, and the tank until the optimum temperature is reached. After completion of this step, the slurry is pumped to a filter press, and then to a cooler and storage. Compressed air and/or pump circulation, or open steam plus circulation at the higher temperatures, may be used to keep the clay in suspension.

Fig. 3 is a flow diagram of a somewhat similar method except that the hot clay-oil mixture from the heater does not return to the tank in which the slurry was mixed but goes to a stripping tower and then to the press, cooler, and storage.

Fig. 4 is a system for continuous, moderate temperature contacting. Part of the charge is withdrawn for mixing with the clay and this heavy slurry is then put back in the main stream. An exchanger is used as a source of heat, and the surge tank is of such size as to provide approximately the proper contact time, plus holdup while the press is being dumped and cleaned.

Fig. 5 shows a batch operation using a shell still. Part of the charge is pumped directly to the still where it is heated. The remainder of the charge is pumped to the mix tank and the clay added. When the oil in the still has reached a high-enough temperature to allow for the addition of steam without condensation, the slurry is slowly pumped to the still so that the temperature is maintained constant. Steam is used for agitation and the still is tilted slightly to facilitate complete removal of the oil and clay at the conclusion of the run.

The method of contacting shown in Fig. 6 is for use in conjunction with a stripping operation. In this flow the residual heat of the bottoms from the fractionating column furnishes the temperature for contact and the clay is added directly to the hot oil. An agitator insures thorough mixing and open steam is used for stripping as well as for aiding in the agitation.

The principle disclosed in Fig. 6, i.e., use of residual heat to avoid the construction of a contact heater, has also been applied in the flow diagram of Fig. 7. Here, however, the clay is mixed with preheated finished oil and added as a heavy slurry to the oil in the bottom of the fractionating column, where most of the contacting takes place. From the bottom of the tower the oil goes to an exchanger, small surge tank, filter press, cooler and storage.

Fig. 8 again shows the utilization of existing fractionation facilities as part of the contacting equipment; this arrangement of Fig. 8 is patented under the name of Filtrol Fractionation and has been described in greater detail elsewhere.* As may be seen

*M. M. Moore and H. M. Gwyn, Refiner & Natural Gasoline Mfr., Feb. 1939.

from the diagram, the raw stock is mixed with clay and charged to the tube still and fractionating column. Process steam both strips the slurry and agitates it to keep the clay in suspension. A pump withdraws the clay-oil mixture from the bottom of the column after suitable contact time and discharges it into a surge tank. The press charging pump takes suction on this tank, for filtering, etc. Sidestreams from Filtrol Fractionation after stripping and cooling are taken as finished products.

Points on Design

In designing a contact plant certain considerations should be borne in mind:

(a) Optimum contacting conditions of time and temperature for the oils which are to be treated.

(b) Point at which the contacting operation most conveniently fits into the flow of products within the refinery, both from an economical as well as physical standpoint.

(c) Equipment which is available for the construction of the contact plant and for its operation under the optimum conditions at the location selected.

Contacting is a simple process and the designer should adhere to its simplicity. The above items are mentioned only to point out that the refining of the lubricating or specialty oil should be considered in all its phases, and if it is desirable to increase the throughput by means of contacting, some thought should be given regarding the best place to put in the contacting operation rather than just "tacking" it on at the end.

Time and Temperature Effects

The optimum conditions of time and temperature for contacting are very easily determined in the laboratory and in most instances the plant and laboratory determinations are in excellent agreement. The extent of oil decolorization is of interest to refiners as it is generally a measure of improvement in oil quality. Figs. 9 and 10 show the change in decolorization efficiency with an increase in temperature when contacting the four main lube stocks—Pennsylvania, solvent-treated Mid-Continent, acid-treated Mid-Continent, and naphthene base—for the same length of time.

Fig. 11 shows the change in decolorization efficiency with an increase in contacting time.

Decolorizing efficiency refers to the comparative amounts of color removed by two clays as measured on the optical density or some other suitable color scale. That is, if a charge of 10 lb. of standard bleaching clay per barrel of oil will yield an oil of 400 o.d. color while 14 lb. of this standard material is required to give the same result at a lower temperature, the decolorizing efficiency of the standard under initial conditions of contact is arbitrarily called 100 per cent and the efficiency at the lower temperature is 10/14 × 100 = 71 per cent.

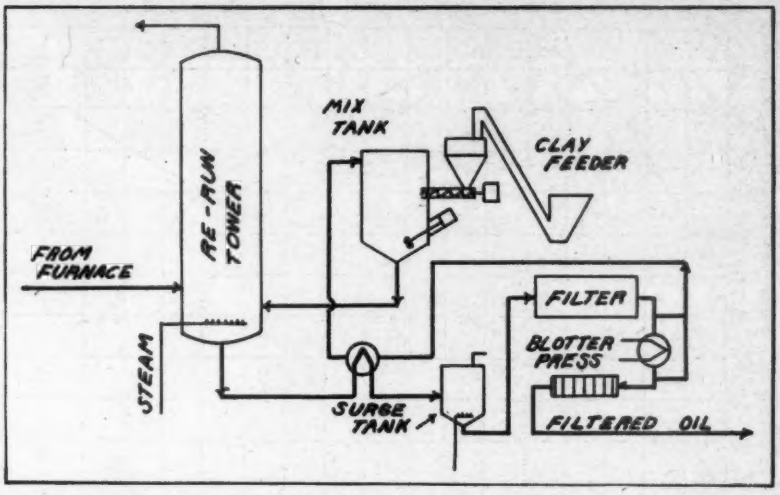

Fig. 7—Clay is mixed with preheated finished oil and added as a heavy slurry to the oil in the bottom of fractionating column, where most of the contacting takes place

Contacting time is generally considered to mean the length of time during which the clay and oil are maintained at the maximum temperature; the time required for heating up to and cooling down from this top temperature is not taken into account.

By referring to Figs. 9, 10, and 11 it will be seen that on stable stocks a slight temperature rise will cause a greater increase in the relative decolorizing efficiency of the clay than will an enormous increase in the length of contact time. For instance, raising the temperature 50° from 550° to 600° F. when contacting Pennsylvania bright stock resulted in a 15 per cent increase in the relative efficiency whereas increasing the contact time 48 fold only raised the relative efficiency 6 per cent.

In the processing of specialty oils certain inspections are of as much or more importance than color. For example, Table 1 shows the effect of two contact temperatures on the Indiana stirring oxidation* values of a high-grade aviation oil. These aviation oils do not develop sludge or varnish in a reasonable length of test time, as was shown by comparing the inspections of actual drain oil, paper filtered, with oxidized samples where 5 hours in the oxidation machine gave

TABLE 1

	A	B	B
Clay (activated type)			
Contact temp., °F.	475	475	525
Clay charge, lb./gal.	0.5	0.5	0.5
Original NPA color	7	—6½	6
Neut. No. after 60 hr.	3.5	4.2	3.0
Loss in weight of Cu strip after 60 hr., mg.	10.7	8.2	3.8
SSU rise at 210° F.:			
After 20 hr.	...	34.5	35.0
After 60 hr.	245	206	162

*Lamb, Loane, and Gaynor, Ind. & Eng. Chem., Analytical Ed., May 15, 1941.

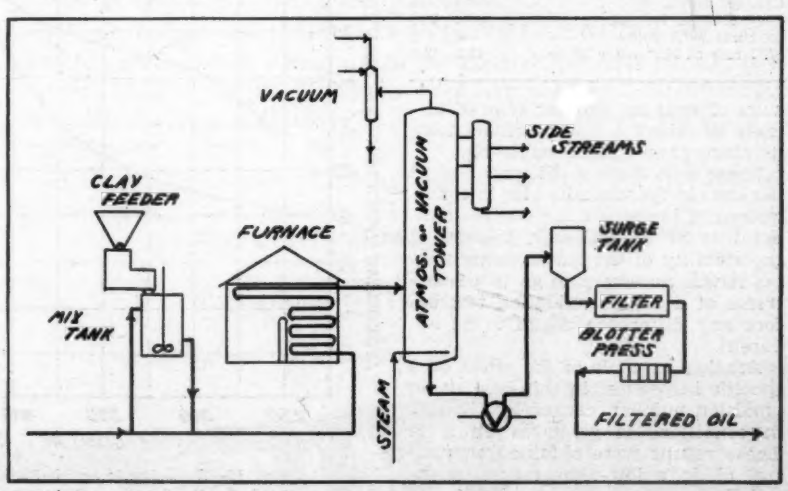

Fig. 8—Utilization of existing fractionation facilities as part of the contacting equipment

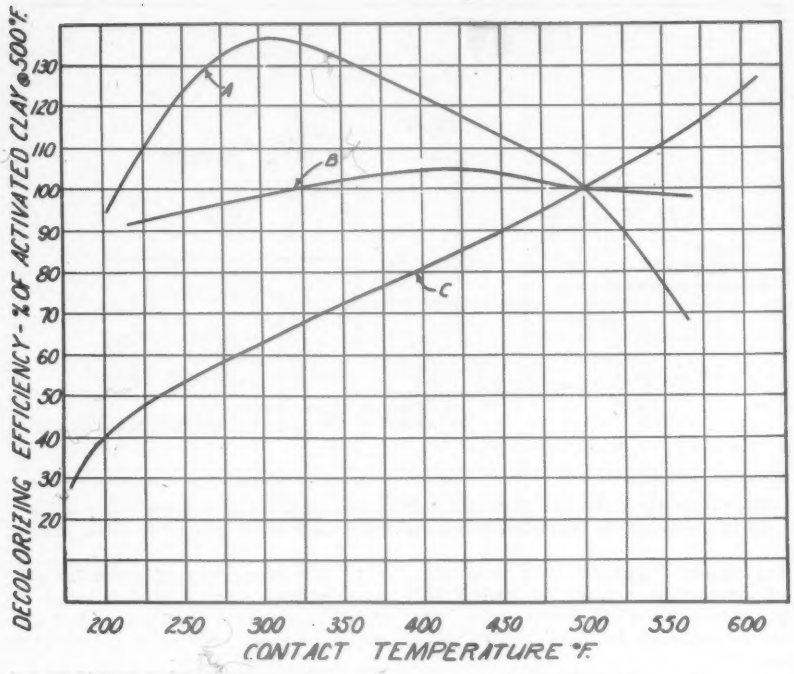

Fig. 9—A—Naphthene base oil, 100 vis. at 100° F. B—Acid-treated naphthene base oil, 90 vis. at 210° F. C—Pennsylvania bright stock, 150 vis. at 210° F. Contacting lubricating oil for 20 minutes

about the same degradation as actual use. For that reason the viscosity rise and corrosiveness instead of the number of hours required to form 10 mg. of sludge were employed as the criteria of the best contacting temperature.

This test indicates that a higher temperature of contact gave a slightly more stable oil and therefore, other inspections being equal, as they were in this case, 525° F. would be selected as the best temperature to use. On the other hand, Table 2 shows the results of tests on another type of aircraft oil where a lower contact temperature gave a more stable oil.

TABLE 1

Clay (activated type)	B	B
Contact temp., °F.	425	475
Clay charge, lb./gal.	0.15	0.15
Original NPA color	—6	5¾
SSU rise at 210° after 20 hr.	12.3	18.0

These data show a difference of 50 per cent in the viscosity rise in consequence of increasing the contact temperature 50° F., although, because of the stability of the stocks being tested, it was necessary to go to the extreme of a severe oxidation test before any difference began to be apparent.

Another example of the effect on a specific inspection, in this case steam emulsion number, caused by changes in conditions is given in Table 3. These results were obtained on neutral oil in a low-temperature, open-vessel operation.

The S.E. number was seen to improve with increased clay charges, but showed a degradation when the contact time was too long.

In general, it has been found that the difference between meeting and failing to meet an oil inspection arises from some minor item in operation or a very small quantity of impurity. If the effect of variations in time, temperature, clay charge, steam stripping, etc., are evaluated beforehand, the data obtained will be of aid in selecting, installing, and operating the contacting equipment.

TABLE 3

Contact Temp. (°F.)	Contact Time (min.)	Lb. clay per gal.	NPA color	A.S.T.M. steam emulsion No.
200	15	0.08	1¾	425
200	5	0.23	1½	64
200	15	0.23	1½	45
200	30	0.23	1½	80
200	15	0.38	1½	35

Adsorbents

Three main classes of contact clays are employed commercially: natural, activated, and synthetic. Many good natural-clay deposits have been developed during recent years and this inexpensive type of material is widely used by the petroleum industry. However, the somewhat more costly chemically activated clays are still several times as efficient as the natural adsorbents, and offer certain advantages in that only a fraction of the handling is needed, and by the use of less clay, the loss of oil retained in the cake is correspondingly reduced. It should be pointed out that by varying the processing during manufacture, a clay may be devel-

(Continued on Page 128)

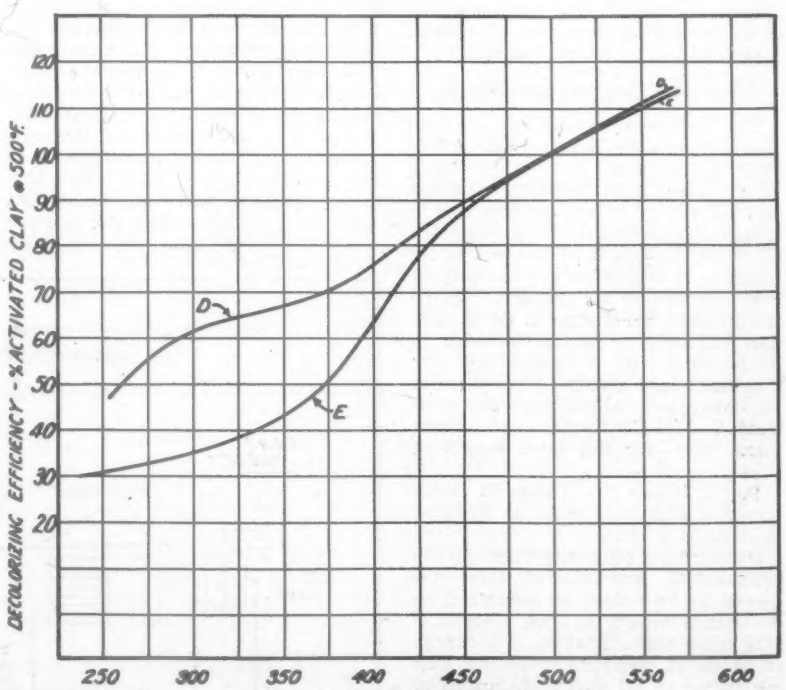

Fig. 10—D—Solvent-treated Mid-Continent bright stock, 150 vis. at 210° F. E—Acid-treated Mid-Continent undewaxed cylinder stock, 150 vis. at 210° F. Contacting lubricating oil for 20 minutes

Petro Union "Extras"

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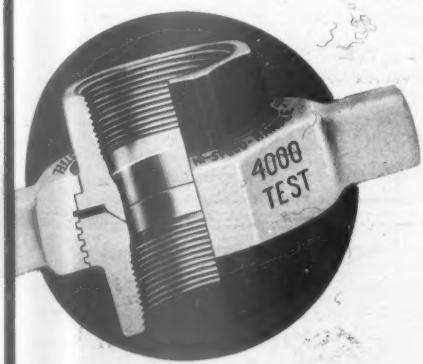
Designed especially for the Petroleum industry, the Petro Union is constructed with heavier end pieces . . . nut threads are permanently lubricated and rust-proofed and will not gall or freeze. Petro Unions conform to the Navy dimensional and physical specifications for steel to steel seat, forged Steel Unions, both threaded and socket weld.

WORKING PRESSURE, POUNDS PER SQ. INCH				
	STEAM OR HOT OIL			COLD WATER, OIL OR GAS, NON-SHOCK
Black or Udylited	500° F	750° F	850° F	
	1150 lbs.	830 lbs.	630 lbs.	2000 lbs.



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With a safety factor against rated working pressures of approximately 5 to 1, the PETRO and HANDLE-BAR forged steel unions offer the MAXIMUM safeguard against extreme pressures and temperatures as well as against stretching and distortion.

In addition to the PETRO and HANDLE-BAR unions, Clayton MARK and Company manufacture the HYDRO, bronze to bronze seat, and the MARK A.A.R., bronze to steel seat unions . . . all interchangeable, part for part with the PETRO union. The bronze seats are completely fused to the steel by a new method of brazing.

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SERVING THE OIL AND GAS INDUSTRIES

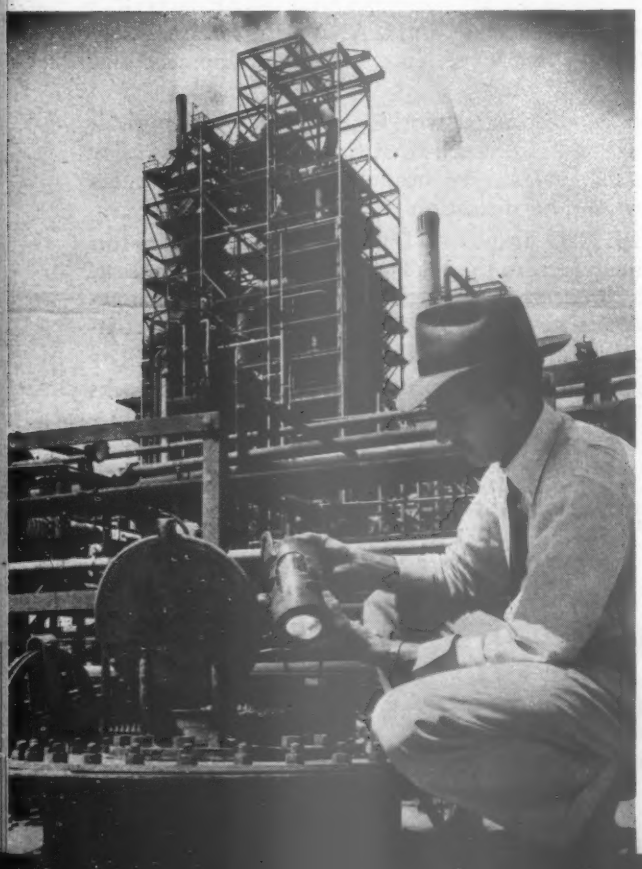
REFINING

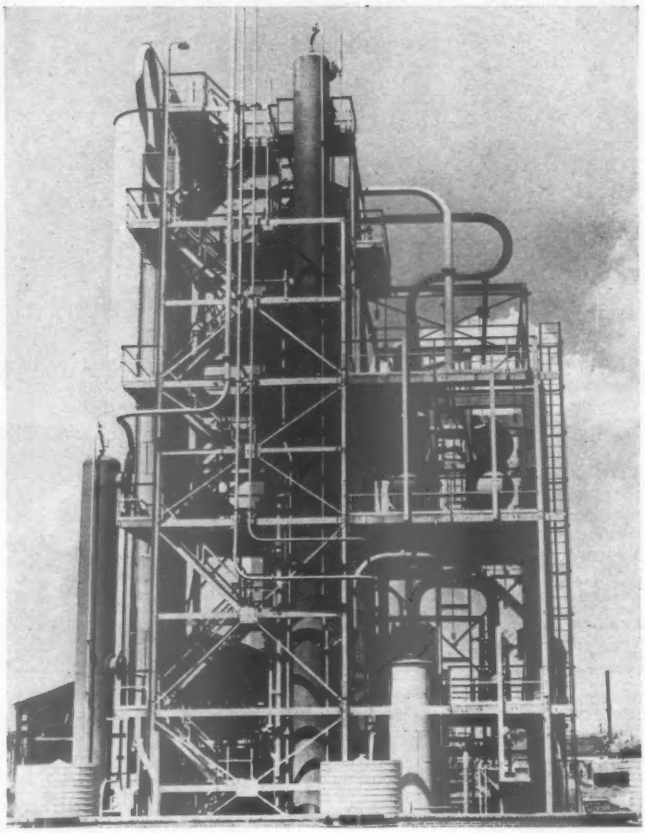
ABOVE

Aviation-fuel plants like this alkylation unit are being rushed to completion all over the country. This is a new unit of the Standard Oil Co. (New Jersey)

BELOW

Aviation base stock is being sampled through a gage hatch as the tempo of fuel production shows increase



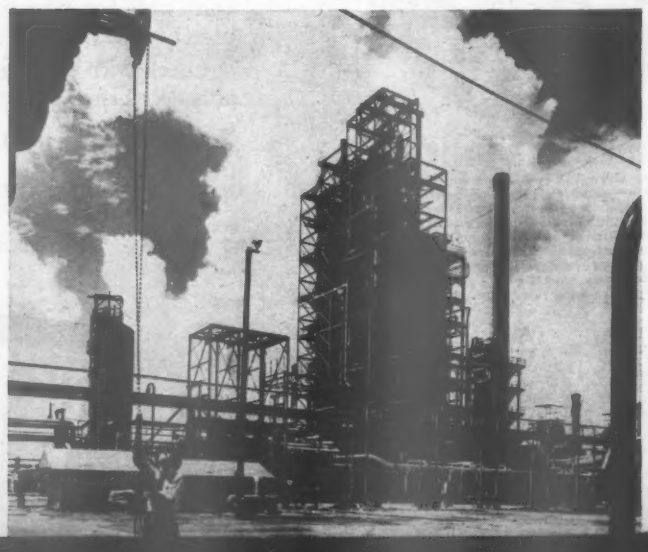


ABOVE

A Polyform unit in a refinery of Socony-Vacuum Oil Co., Inc., contributes to motor and aviation fuel production for war

BELOW

Driven to its capacity limit, this unit, one of the earliest of Standard of Jersey, is making aviation superfuel base stock



IN 1943

ABOVE

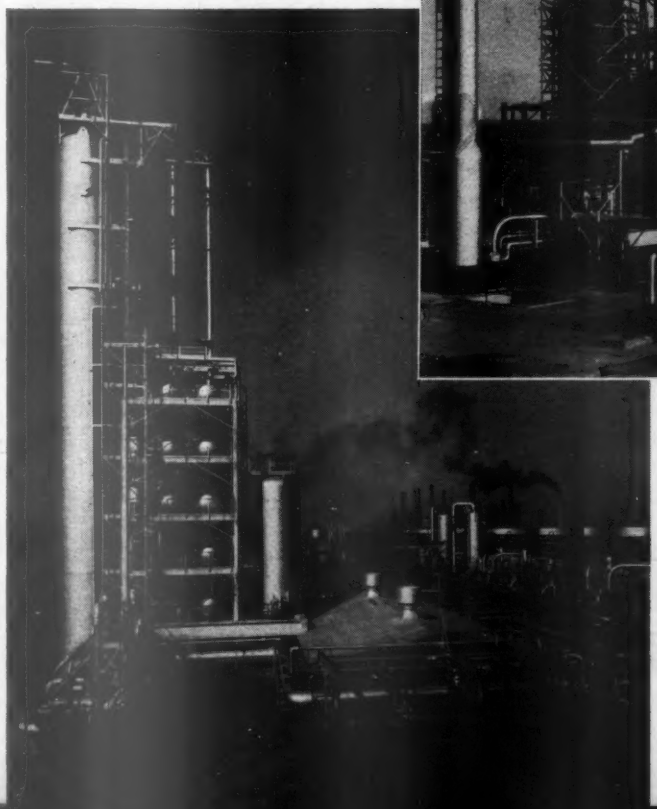
Proof of the pudding: Test engineer controls an altitude test room, where fuels are studied under artificially produced high-altitude conditions

LEFT

Some idea of size is obtained by observing this workman alongside a huge conduit in an eastern fluid-catalyst cracking unit

ABOVE

A Houdry "cat cracker" in the Southwest uses the peculiar properties of catalysts to meet the requirements of our aviation-fuel base stock needs



LEFT

A Socony-Vacuum alkylation unit in the Southwest pours out aviation-fuel stocks to "keep 'em flying"

DAKAR—WEST AFRICA

400 Miles

South of the Sahara

When our troops swung into Dakar, they found Layne Wells and Pumps on the job, producing millions of gallons of water daily. The Dakar installations had been made under the direction of Layne engineers and are identical with the famous high efficiency, long lasting Layne Wells and Pumps now serving your own local cities and industries.

Layne Wells and Pumps are in use throughout the African War Zone. They were chosen from a field of world wide competitive makes. The reasons for their selection are quite obvious; more skilfully designed, more ruggedly built and more efficient in operation. In war as in peace, their dependability has never faltered.

Tremendous quantities of well water is an absolute war necessity and today hundreds of speedily installed Layne Wells and Pumps are serving aircraft makers, ordnance works, munition factories, chemical plants, ship yards, flying fields, troop training areas and navy yards. Present production is now nearly 100 percent for the war needs, but every effort is being made to keep private and municipal installations in operation.

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Contact Filtration Aid To Wartime Production

(Continued from Page 124)

oped to meet a particular need. Several such new-type adsorbents have been produced within the past several years. These developments have generally led not only to improved quality of the contacted oil but also to lowered costs.

Equipment Requirements and Costs

The two main items of equipment expense in the construction of a contact plant will undoubtedly be the heater and the filter. The cost of a furnace for a 1,000-bbl. per day plant will vary from $5,000 for a new unit down to nothing where the contact plant is combined with existing equipment such as the Filtrol Fractionation arrangement of Fig. 8. For filters the Sweetlands is widely used in refinery practice and some of its characteristics in the two most common sizes are listed in Table 4.

TABLE 4

Size of Sweetlands Press	No. 10	No. 12
Inside diameter, in.	31	37
Inside length, in.	109	145
Approx. volume, bbl.	8	16
No. leaves with 4-in. spacing	27	36
Filter area in sq. ft., smooth rim leaf	262	502
Max. cake capacity, cu. ft., 1½-in. thickness	33	63
Approx. throughput, gal./hr. (filtering 150 vis. at 210° F. cyl. stock at 350° F.)	625	1,200
Total weight filled with water, lb.	16,500	29,600

Estimated cost, second-hand to new, $9 to $19 per sq. ft. per filter area.

These estimated costs are for filters complete with 250-mesh Monel metal screens; naturally the price of second-hand equipment is subject to wide variations. The type of precoat filter shown in Fig. 1 is slightly more expensive than the Sweetlands filter, or filters, of the same throughput capacity. However, because the filter is continuous no specific shift labor need be applied to the operation of this equipment. And, furthermore, as the oil must pass through the precoat of diatomaceous earth, there is no necessity for having a blotter press to remove the small quantity of fines which work through the screens of other filters.

A recent estimate for increasing the capacity of a 400-bbl. per day Pennsylvania aviation oil percolation plant by adding contact filtration facilities (mostly from salvage) was $15,000. Almost all the materials in this case were immediately available. The total fixed and variable operating costs, i.e., steam, labor, maintenance, fuel, power, but excluding clay cost, for this plant were calculated to be about $0.0025 per gallon. Balanced against these low investment and operating charges would have been the cost of an additional percolation or solvent treating plant with their requirements of large quantities of critical materials.

Conclusion

As the number of planes and tanks in actual combat is increased, the governmental requests for high-quality lubricating oils will rise proportionately. Also, there is an increasing demand for superior products at the very time when the ability to obtain these production facilities is decreasing. This situation increases the burden on the present percolation or solvent treating plant, but to increase the throughput will decrease the quality, or to increase the quality will decrease the throughput.

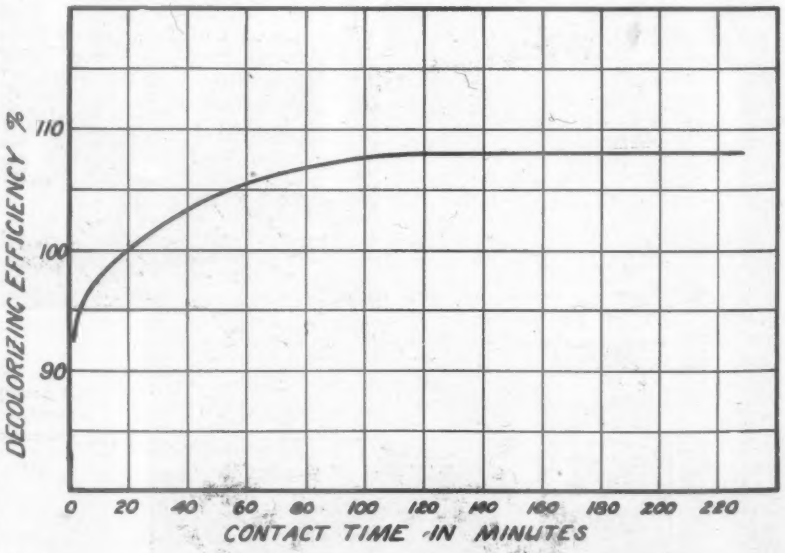

Fig. 11—Contacting Pennsylvania bright stock at 550° F. Decolorization efficiencies are on the basis of the color obtained in 20 minutes contact time

War Needs Bring Many Changes in Processing

(Continued from Page 86)

genate rather smoothly to form aromatics.

The gigantic task of producing a million tons per year, or more, of synthetic rubber involves the construction of close to a billion dollars worth of new equipment. While not all of these is petroleum-type equipment, a majority of it is, whether it is built by petroleum companies, chemical companies or rubber companies. When this is added to the aviation gasoline program and the toluene program, it is small wonder that the petroleum industry and the government bureaus are bedeviled with priorities. Even in peacetime, with no problem of building a Navy, merchant marine and mechanized Army, it would have been a task for "Superman." Today we can resign ourselves to delays and postponements and smaller and smaller supplies of civilian rubber, with no relief in sight before late 1944—if indeed then.

A review of the methods to be used in preparing butadiene and other rubber intermediates was published in The Oil and Gas Journal, November 25, 1942. The chief processes for making butadiene, as incorporated in the regular program, are: (1) catalytic dehydrogenation in two stages of n-butane; (2) catalytic dehydrogenation of n-butylenes. In the so-called "Refinery Conversion Program", three processes are to be used: (a) Houdry catalytic dehydrogenation of a mixture of n-butane and n-butylenes; (b) tubular cracking at 1250° to 1350° F. of naphtha and gas oil; (c) the T.V.P. process.

A flow sheet of the latter in simple form is shown in Fig. 6. Naphtha is passed through a heating coil, to raise the temperature as rapidly as possible to 1300° F. It is then mixed with gases from the depropanizer top which have been heated to 1500° F. in another coil. The mixture at 1350° F. enters a reaction chamber for a short time, and upon leaving the chamber these vapors are quenched to 600° F. The quenched vapors are fractionated to produce a depentanized aromatic distillate, fuel oil and a gas stream containing the C_4 and lighter fractions. The fresh naphtha charge is used as an absorption oil to strip the compressed gases of all of the C_4's and as much C_3's as may be needed for heat-carrying purposes. This fat oil is then depropanized and the bottoms from the depropanizer are charged to the debutanizer. The overhead from this column is extracted for its butadiene content and the bottoms from the column make up the charge to the unit.

The synthetic-rubber industry may well be the means of revolutionizing the carbon black industry also. The old channel black process produces a product which is very satisfactory for natural-rubber compounding but which accentuates some of the present deficiencies of buna-S type rubbers. On the other hand, the softer furnace blacks appear to better advantage with the synthetic rubbers. Since the channel process seldom yields 10 per cent of carbon, based on the carbon content of the gas burned, conservation will be aided by the newer developments. Furnace black processes frequently yield as much as 40 to 50 weight per cent of the carbon content of the feed stock, and furthermore will handle liquid oil as well as gaseous charging stock. The processes are much more susceptible of careful control and a correspondingly more uniform product may be expected from such operations.

For many years research workers have attempted to make acetylene from natural gas or liquid petroleum hydrocarbons. Small quantities always turned up in high-temperature processes to plague operators with separation problems, but no commercial units were installed. A few years ago Tennessee Eastman Corp. carried on a long series of experiments with the Wulff process, and today a plant to produce 150,000 lb. of acetylene per day is being installed by a large chemical company. A simple flow sheet of the process is shown in Fig. 7.

The reactor is a regenerative type heater in which the refractories are spaced so as to give very high gas velocities during the "make" period. A considerable volume of steam at low pressure is used to maintain a low partial pressure of the acetylene produced. The feed employed may be anything from ethane up to kerosene. Ethylene produced in the process is recycled in order to increase the yield of acetylene, and its concentration in the exit gases.

It is difficult to predict what may be the effect of such a commercial venture as this acetylene making unit. If it has a long enough operating history before the war ends to demonstrate its ability to make cheap acetylene, future installations may well be of this type. On the other hand, unless it is able to compete with existing units in the postwar period, it may succumb to cheap electricity and the inertia of an established industry.

Whatever may be the economic value of the particular units now being operated or installed to produce war material, we can be certain that our industry is advancing in technical developments as it never has before, and that we shall see a chemical industry of unprecedented size grow out of these developments. The technique which is making possible the large-scale production today of such products as isobutylene, butene-1, butene-2, butadiene, isoprene and acetylene will scarcely fail when peacetime industry demands these and countless other organic chemicals as raw materials for the synthesis of products to fill needs of which we are today unaware.

Editor's Note: This article has been specially prepared for publication in The Oil and Gas Journal; one section of it is not included in this issue.

Here are the huge "converters" for transforming aviation superfuels into the terrific energy required to drive fighting planes at present battle speeds

Marine Locations
COMPLICATE WILD WELL OPERATIONS

Above—A huge dredge boat and several tugs were floated in to remove the wreckage and assist with the capping operations on this blowout—a water location on the Louisiana coast. Below—This marine location, being drilled from a submergible barge, won't blowout for want of drilling control equipment.

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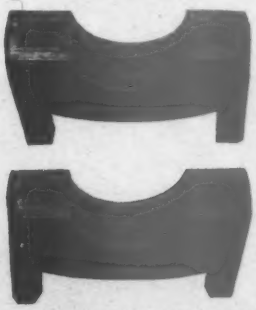
BLOWOUTS THAT DIDN'T HAPPEN!



. . . PIPE THAT DIDN'T STICK!

The worn condition of this set of ram packers, removed from a Cameron Type SDA Blowout Preventer, graphically tells the story of blowouts that didn't happen and of drilling strings that didn't stick. They offer proof that Cameron Blowout Preventers not only close the annular space swiftly and positively when required to do so, but also permit movement of the pipe through the closed rams to prevent sticking.

At best, wild wells are hazardous and costly, frequently requiring months of painstaking work to bring them under control. Marine locations, with their ever-present danger of water pollution, slow boat or barge transportation and other natural barriers to speedy operations, complicate even the complexity of problems encountered on dry land.

The obvious conclusion to be drawn is to take absolutely no chances with drilling control equipment of questionable safety, especially on marine locations.

Mechanically, and from the standpoint of safety and control, there are no other units to compare with Cameron Pressure-Operated Drilling Control Equipment. To mention but a few reasons: *They close instantly*—Pressure supplied by boiler feed pump, slush pump, or both, remotely controlled from the derrick floor, closes rams and ram gate instantly. (Manually operated units also available, if desired.) *They seal unfailingly*—Patented self-feeding packing elements in blowout preventer effect a positive seal the instant closing pressure is applied. Ample reserve of resilient packing material permits rotating and moving pipe in hole safely under pressure. The self-feeding packing element in the valve ram gate automatically feeds out and effects a pressure-tight seal even though the seat should be roughened, corroded or sand cut. *Pipe is centered automatically. Well cuttings cannot prevent closure. There is no upstream or downstream side. Rotate and spud through closed preventer rams. Four-to-one holding ratio provided.* These and other features of Cameron Pressure-Operated Drilling Control Equipment are fully explained in your Composite Catalog.

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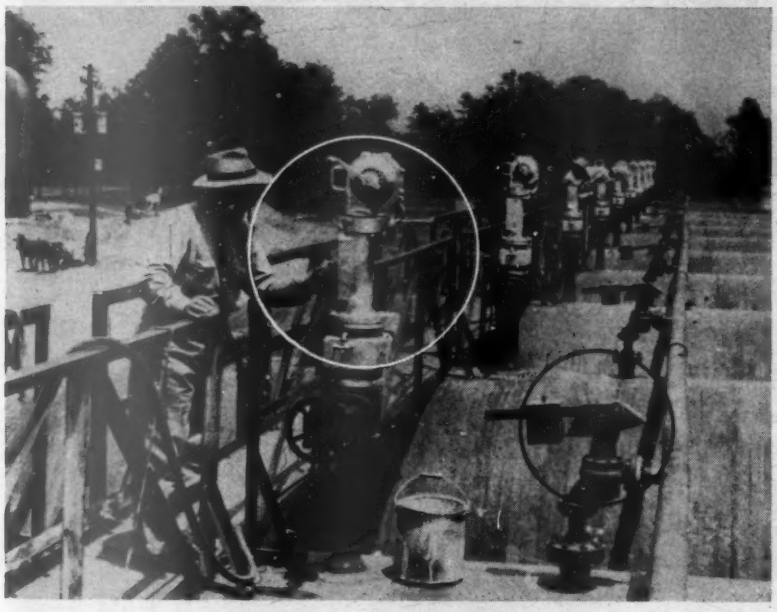
Synthetic Rubber

(Continued from Page 89)

ments of individual applications in industry, improving further the advantages of the synthetic over the natural product. A tremendously extended research field is opened up in and for rubber synthesis to make better synthetics and individual products highly suited to a greater number of specific applications. Research on these extensions of the synthetic field is subservient to the demands of the immediate and critical situation of "adequate rubber supplies at any price." Relief in this immediate crisis may be expected to release more research facilities to investigate more intensively other phases of the problem on a long-time-realization basis.

At present no styrene is being made from petroleum-derived benzene so far as has been announced although it is highly possible that benzene made from petroleum as a byproduct of other processes or by direct means may find its way into this synthesis before the war is over. Either alcohol or ethylene from hydrocarbon gases is employed for alkylation of benzene by dehydration of the alcohol, subsequent alkylation and dehydrogenation of the side chain to ethylene; or alkylation of benzene direct with ethylene and subsequent dehydrogenation of the ethyl side chain to ethylene. Benzene may be alkylated directly by acetylene, theoretically, but so far as has been announced no commercial process for this purpose is being used at present. Again the postwar solution of a commercial source of styrene will be determined by economics as it is implemented by process development.

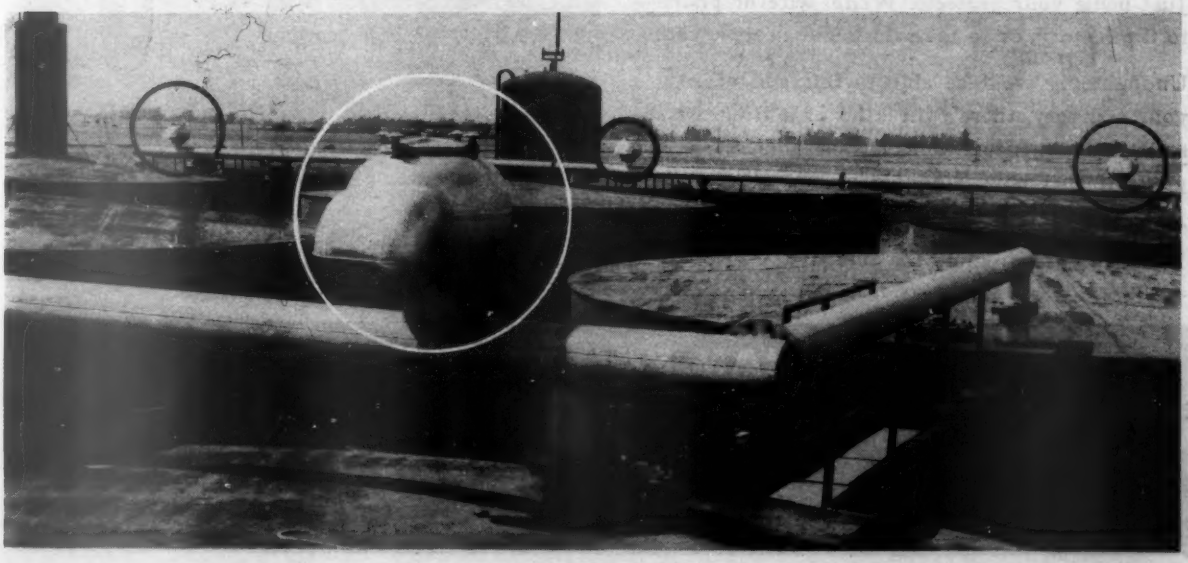
Most promising of all rubber developments probably is the extension of our knowledge of chemicals and their application to the modification of synthetic-rubber properties. Developments in this field which are blanketed by secrecy at present include plasticizers, antioxidants and a long list of modifiers and along this line lies one of the major solutions of the synthetic-rubber problem.



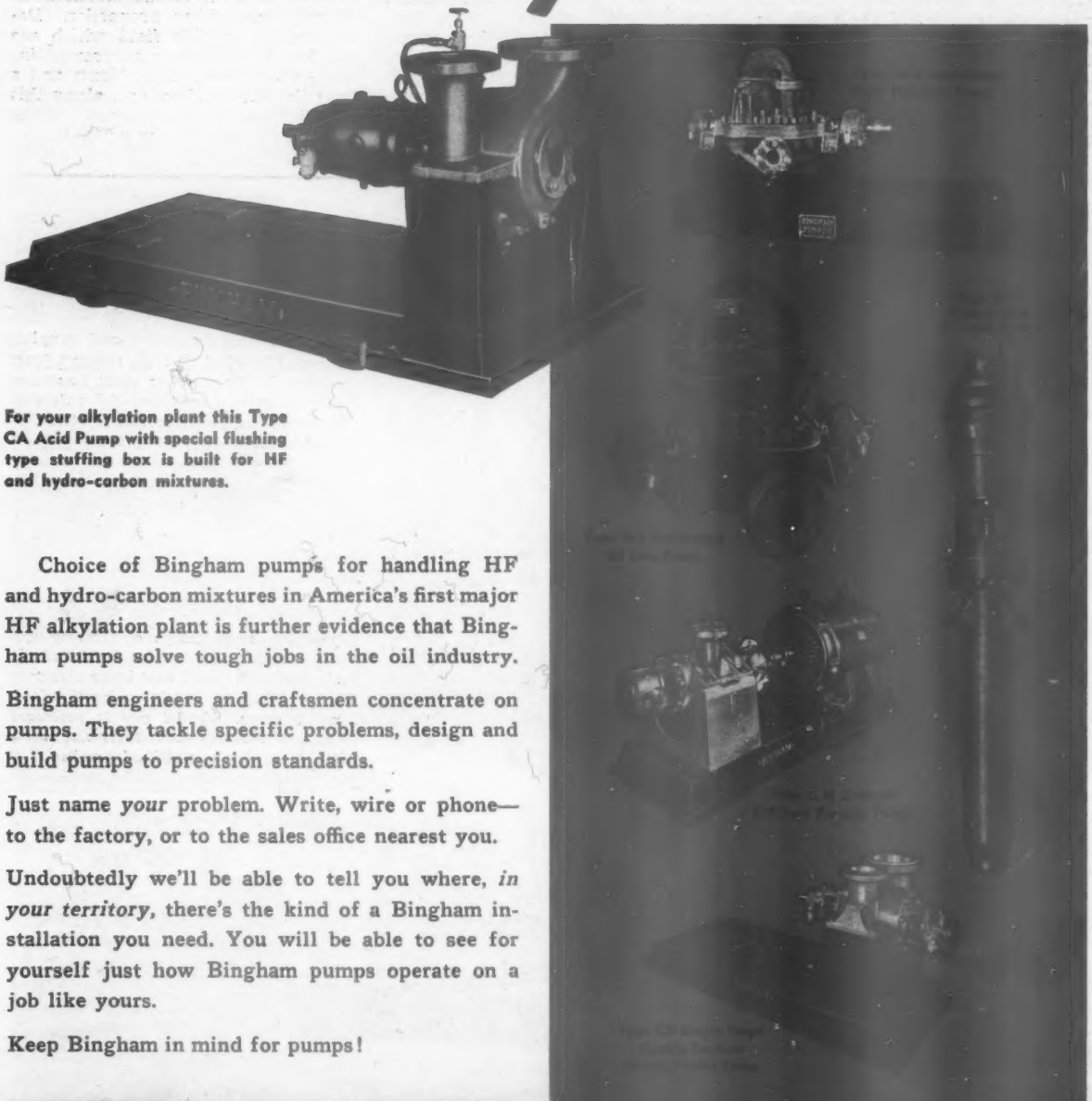
Vapor Saving Doubly Important

***Left:** Varec gastight gaging and sampling equipment installed on 85-lb. pressure tanks at Cotton Valley recycling plant, Louisiana. The vacuum and pressure-relief valves at right vent gas to a recovery system connected to the main plant system*

***Below:** The same design of recovery system installed in the Douglas Oil & Refining Co.'s California plant, now being disassembled and sent to Russia under the lend-lease program. Vented gas is processed through a recovery unit, recovering some 100 bbl. per day of stabilized gasoline*



FIRST MAJOR HF ALKYLATION PLANT CHOOSES *Bingham* PUMPS



For your alkylation plant this Type CA Acid Pump with special flushing type stuffing box is built for HF and hydro-carbon mixtures.

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Refining of High Melting-Point Waxes

(Continued from Page 101)

essentially oil-free material with the use of only small amounts of solvent. Too rapid cooling rates resulted in poorly crystallized, bulky wax cakes which cracked badly on filtering and washed unevenly.

In cases where the low oil content of the crude wax made it desirable to add a diluent before chilling in order to reduce the stiffness of the resulting slurry, it was found that if oil of too low molecular weight were used the wax crystals obtained were solvated or contained absorbed oil and had a gelatinous consistency. The gelatinous character of such wax crystals was retained after dilution of the slurry with the leaching solvent, and such slurries filtered slowly and resulted in imperfectly deoiled wax cakes. On the other hand, if in such cases the leaching solvent was used as the diluent during cooling to reduce the stiffness of the slurry and render it pumpable at all times, it was found that the amount of the diluent added and the temperature at which it was added were of extreme importance. If too much solvent was added or if the solvent was added at too high a temperature, the wax separated in a bulky, compressible form and the wax cakes obtained on filtration cracked badly. This resulted in poor washing and the production of oily wax. It was found that suitable slurries resulted if no solvent was added until the major portion of the high melting point waxes had separated, and if the volume of solvent added was no more than about 10 or 15 per cent of the crude-wax volume. Best results were obtained when the temperature of the solvent added was the same as that of the crude wax to which it was added.

Wax Pilot Plant

All of the waxy raffinates examined have been so low in total wax content that no predilution with oil is required during the cooling of them to form suitable slurries.

It should be pointed out that although many waxy long residium raffinates and crude waxes from such raffinates can be deoiled successfully by this process, the presence of the petrolatum-type wax contained in such materials usually leads to low filter rates and poor color in the finished product. Therefore, it usually is preferable to distill a petrolatum-free fraction from such stocks for deoiling rather than to deoil the whole material.

As soon as sufficient laboratory data had been obtained, a pilot plant was constructed and engineering data obtained for the design of a commercial installation. This pilot plant, which is still operated on crude wax and waxy raffinate samples submitted by other refiners, consists of a wax chiller, a vessel equipped with a high-speed electric-motor-driven stirrer for mixing the chilled waxy charge with the solvent, calibrated vessels for solvent storage, a solvent recovery column, a 1 by 1-ft. laboratory-type Oliver continuous-vacuum filter, and the necessary pumps for transferring solvent and wax slurry.

The chiller consists of a water-jacketed 6-ft. length of 12-in. pipe which is mounted vertically. It is equipped with a double-acting steel stirrer of conventional ice-cream-freezer-type construction which is driven at 10 r.p.m. by an electric motor through a belt reduction, a small 100-to-1 gear-reduction unit, and the gear mechanism from a 5-gal.-capacity ice-cream freezer. Through its water jacket a 1-in. centrifugal pump circulates water from a 50-gal.-capacity reservoir equipped with an overflow. The temperature of the water in the reservoir may be varied at will by the use of steam, tap water, and iced water, and hence the rate of cooling of the waxy material charged to the chiller may be regulated very closely. Some time

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after the plant was built a section of a conventional scraped double-pipe continuous chiller was installed for the purpose of obtaining final data for commercial-plant design, but the batch chiller is much to be preferred for small-scale operations.

The vessel in which the chilled waxy charge is mixed with the solvent is of 50-gal. capacity. The actual mixing may be accomplished either by circulation of the chilled wax and solvent by means of a 1-in. gear pump, or by a Lightnin' Mixer installed in the mixing vessel. With certain crude waxes it has been found that mixing by gear-pump circulation is harmful if the material is circulated through the pump for too long a period as the wax crystals are ground so fine that slow filtration results. Ordinarily about 2 minutes of mixing with the high-speed stirrer is sufficient to disperse the chilled wax and dissolve completely the adherent oil.

Laboratory Filter Units

The 1 by 1-ft. laboratory-type Oliver continuous-vacuum filter is mounted above the mixer and the excess slurry fed to it by a pump returns by gravity flow from the filter tank overflow to the mixing vessel. The unfiltered slurry held up in the system at the conclusion of a run amounts to approximately 2.3 gal. The wash solvent is dripped onto the wax cake on the filter from four ¼-in. brass pipes spaced at 2-in. intervals. These pipes are fed from a common header by a pump, and have a line of $\frac{1}{16}$-in.-diameter holes drilled on ½-in. centers on their lower sides. Short lengths of wire twisted around these pipes between the holes help to distribute the wash solvent evenly and prevent it running in a single stream from the low point on each pipe. The filter is equipped with separate receivers for filtrate and wash liquid, and hence different amounts of vacuum can be maintained on the filtering and washing sections. The washed wax cake is removed by air blow and scraper bar in the conventional manner. The filtrate and wash liquid receivers are calibrated and fitted with gage glasses, and may be emptied by pump without disturbing filtration operations during the course of a run.

The solvent-recovery unit is a simple steam-jacketed stripper column. The combined filtrate and wash liquid from a run are fed to it through a simple steam jacketed coil.

The power for the various pumps and for rotating the chiller stirrer and the filter is supplied by a single motor through the necessary line shafts, clutches, gear-reduction units, and belt drives.

In conducting a run on this unit about 50 lb. of the waxy material to be deoiled is weighed into the chiller at a temperature of around 150°-160° F. The water in the chiller jacket is adjusted to this same temperature, which is above the melting point of the waxy charge, and its temperature is then decreased gradually in order to chill the waxy charge at a uniform rate of not over 1° F. per minute. If the character of the charge is such that it tends to become too stiff before the desired deoiling temperature is reached, an amount of methyl ethyl ketone or a mixture of this solvent with naphtha equivalent in amount to 10 per cent by volume of the waxy charge is added at a temperature of 100° F. and chilling continued. In any case when the desired deoiling temperature, which is usually from 65°-75° F., is attained the chilled waxy material is mixed with the required volume, usually about 1.25 to 1.75 times that of the waxy charge, of methyl ethyl ketone or a mixture of this solvent with naphtha; the solvent added being previously brought to the same temperature as the chilled waxy charge.

This primary slurry is then filtered and washed on the filter with about 0.50 to 1.50 volumes of additional solvent previously brought to the same temperature as the slurry being filtered. The wax cake recovered is weighed, a small sample removed for

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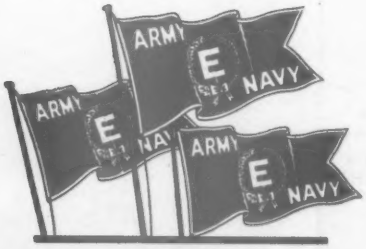

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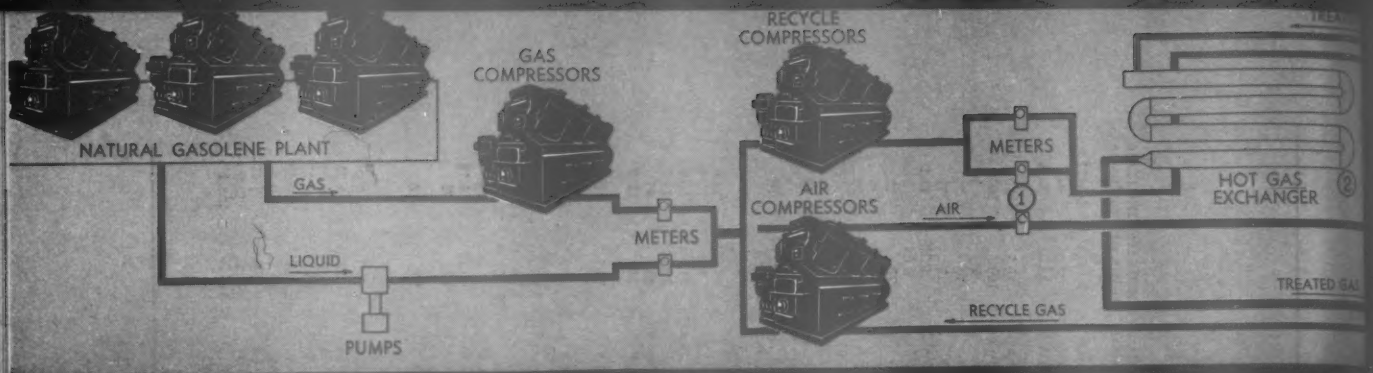
TABLE I—DATA FROM PILOT PLANT DEOILING RUNS ON VARIOUS WAXY PRODUCTS

Nature of charge—	Raffinate crude wax	Raffinate crude wax	52% vacuum overhead following 30.27% O.H. from long residuum raffinate crude wax	Raffinate crude wax	Long residuum raffinate	54% vacuum overhead from heavy raffinate crude wax	Raffinate crude wax	30.27% vacuum overhead from long residuum raffinate crude wax	Heavy raffinate crude wax plus 30% of 38 at 100° F. viscosity gas oil	Distillate raffinate	Distillate raffinate	Distillate raffinate
Run number:	I-2501	I-2507	I-2505	I-2538	I-2540	I-2541	I-2543	I-2544	I-2546	I-2547	I-5113	I-5112
Weight charge, lb.	55	45.6	41.2	41.6	47.1	27.8	35.8	37.8	38.5	54.1	78.5	74
Gravity of charge at 60° F., °A.P.I.	35.2	34.1	33.4	37.4	31.3	35.5	40.2	35.8	34.5	30.8	34.0	32.0
Primary filtration:												
Assumed volume of charge as liquid at 60° F., gal.	7.78	6.41	5.78	5.96	6.5	3.94	5.22	5.37	5.43	7.47	10.9	10.3
Temperature of charge to chiller, °F.	150	150	150	150	150	150	150	150	150	150	160	160
Wax chilling rate, °F./min. (approximate)	1	1	1	1	1	1	1	1	1	1	1	1
Final temperature of chilled wax, °F.	70	65	65	63	60	60	60	60	60	60	72	72
Temperature of solvent added to form primary slurry, °F.	70	70	70	80	70	65	65	60	60	60	72	72
Volume of solvent added to chilled wax, gal.	10	10	9	10	11	8	10	7.5	10	12	9.15	13.2
Volume ratio of solvent to chilled charge	1.28	1.56	1.55	1.68	1.69	2.03	1.93	1.40	1.84	1.61	0.84	1.28
Temperature of primary slurry, °F.	65	65	65	63	60	60	60	60	60	60	72	72
Vacuum used during filter cycle on filter, in. of Hg.	3-5	3-5	3-5	10	10	10	10	3-5	3-5	3-5	6	5-6
Vacuum used during wash cycle on filter, in. of Hg.	10-15	10-15	10-15	10	10	10	10	10	10	10	18-20	18-20
Volume of wash solvent used, gal.	5.73	2.86	3.97	3.96	3.06	2.2	1.76	3.06	3.52	4.41	12.5	7.03
Volume ratio of wash solvent to waxy charge	0.74	0.45	0.69	0.67	0.47	0.56	0.34	0.57	0.65	0.59	1.15	0.693
Temperature of wash solvent, °F.	70	70	70	80	70	65	65	60	60	60	72	72
Time required for filtration, min.	45	35	40	40	60	30	40	25	40	40	55	
Filter drum speed, r.p.h.	10	10	10	10	10	10	10	10	10	10	10	10
Filter rate (based on volume of slurry actually filtered and filter area of 3 sq. ft.) gal./sq. ft./hr.	7.01	8.23	6.60	7.16	4.83	6.87	6.49	9.0	5.99	8.40	7.95	
Weight of unfiltered slurry recovered from system, lb.	14.5	14.1	11.1	11.3	20.0	10.2	13.2	9.0	21.5	18.2	17.8	18.0
Weight of crude wax recovered from unfiltered slurry, lb.	6.52	5.6	4.37	4.32	8.06	3.77	5.26	4.7	8.63	7.38	7.0	7.2
Weight of crude wax actually processed, lb.	48.48	40.0	36.83	37.28	39.04	24.03	30.52	32.6	40.42	46.22	71.5	66.9
Weight of solvent wet wax cake, lb.	28.4	24.2	20.0	31.0	22.6	17.8	23.6	18.5	29.1	16.8	22.0	24.0
Per cent by weight of solvent in wax cake	39.3	32.5	36.3	35.8	52	30.7	29.7	40.3	36.2	42.8	45	47
Calculated weight of oily wax in wax cake, lb.	17.24	16.33	12.73	19.86	10.85	12.35	16.62	11.05	18.6	9.6	12.1	12.0
Per cent by weight yield of oily wax (based on charge actually processed)	35.5	40.8	34.6	53.3	27.8	50.8	54.6	33.9	59.8	20.8	16.9	19.9
Secondary filtration:												
Volume of solvent used to redisperse primary cake, gal.	6.0	7.0	7.0	7.0	7.0	4.5	5.0	5	8	7.5	6.5	7.0
Volume ratio of solvent used to original waxy charge	0.77	1.09	1.21	1.18	1.06	1.14	0.96	0.93	1.47	1.01	0.59	0.68
Temperature of secondary wax slurry, °F.	65	70	65	63	60	60	60	55	60	60	72	72
Vacuum used during filter cycle on filter, in. of Hg.	3-5	3-5	3-5	10	10	10	10	3-5	3-5	3-5	6	5-6
Vacuum used during wash cycle on filter, in. of Hg.	10-15	10-15	10-15	10	10	10	10	10	10	10	18-20	18-20
Volume of wash solvent used, gal.	5	2.2	2.2	3.06	2.64	2.2	1.1	3.06	2.2	1.76	1.9	2
Volume ratio of wash solvent to original waxy charge	0.64	0.34	0.38	0.52	0.4	0.56	0.21	0.57	0.4	0.24	0.17	0.19
Temperature of wash solvent, °F.	70	70	70	80	70	65	65	60	60	60	72	72
Time required for filtration, min.	40	25	25	30	35	20	25	20	25	25		
Filter drum speed, r.p.h.	10	10	10	10	10	10	10	10	10	10	10	10
Filter rate (based on volume of slurry actually filtered and filter area of 3 sq. ft.) gal./sq. ft./hr.	5.0	7.23	6.77	6.68	5.05	5.61	5.57	6.22	8.7	6.78		
Weight of unfiltered slurry recovered from system, lb.	10.4	11.9	9.6	10.5	11.2	9.3	9.9	8.1	9.1	9.8	9.3	9.5
Weight of wax recovered from unfiltered slurry, lb.	2.08	2.85	2.71	2.56	1.91	2.9	3.06	2.12	2.19	1.64	1.8	1.75
Weight of oily primary wax actually processed, lb.	15.16	13.48	10.02	17.3	8.94	9.45	12.69	8.68	16.41	7.71	10.3	10.95
Per cent by weight of oily primary wax actually processed	87.9	82.57	80.1	87.2	82.5	76.5	76.3	78.6	88.2	80.3	85	86.2
Weight of solvent wet secondary cake, lb.	25.4	18.4	16.6	23.2	17.1	14.0	14.6	13.5	23.6	15.4	15.1	12.35
Per cent by weight of solvent in wax cake	49.4	39.0	46.2	42.0	69.8	40.8	30.9	49.0	38.0	60.8	55	60
Weight of deoiled wax recovered from wax cake, lb.	12.86	11.23	8.96	13.7	5.17	8.28	10.1	6.88	14.0	6.03	6.8	7.42
Per cent by weight of deoiled wax	30.2	34.0	30.4	42.7	16.05	44.6	43.5	26.9	50.9	16.3	11.2	12.9
Melting point of deoiled wax, °F., A.S.T.M.	140.2	*155.5	140	139	152	153	129	143	156	158	147.8	163.2

*Petrolatum melting point, A.S.T.M.



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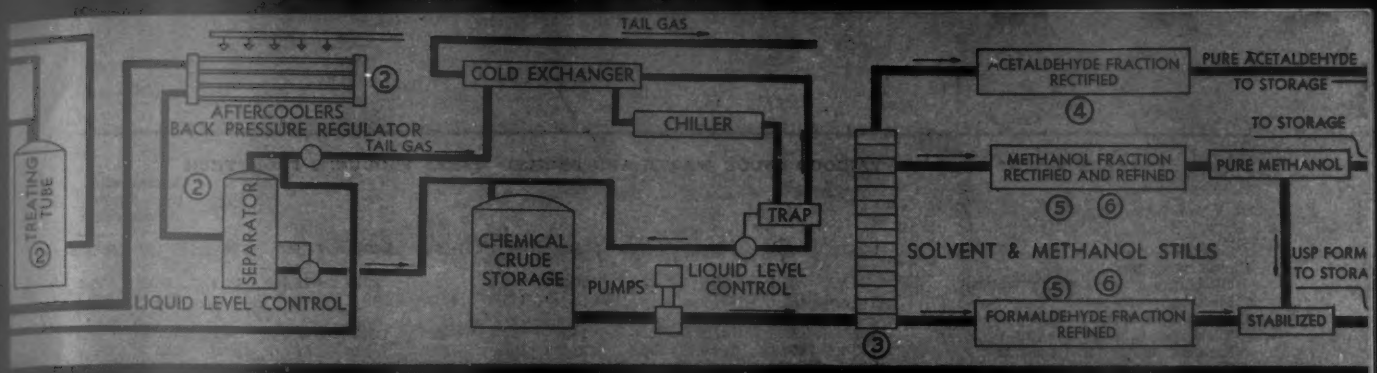

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TABLE 2—TEST DATA ON VARIOUS CRUDE WAXES AND DEOILED WAXES PRODUCED FROM THEM

Sample No.—	I-2501	I-2507	I-2505	I-2538	I-2540	I-2541	I-2543	I-2544	I-2546	I-2547	Commercial production Aristowax 145/150	Commercial production Aristowax 160/165
Crude wax tests:												
Oil content, per cent by weight	46.3	38.3	36.5	22.4	*70.2	16.3	21.6	38.6	16.4	*67.2	60.0	70.4
Melting point, gal., °F.	122	135	137	...	...	143	...	119	147	...	134	133
Deoiled wax tests:												
Yield, per cent by weight	32.0	36.0	32.5	42.7	14.1	39.4	43.5	26.7	45.8	14.7	25.6	16.2
Melting point, °F. (A.S.T.M.)	140.0	†155.5	140.0	139.0	152.0	153.0	129.0	143.0	156.0	158.0	142.3	159.4
Specific gravity	0.9215	0.9289	0.9271	....	0.9231	0.9134	....	0.9220	0.9278	0.9120	0.8950	0.9120
Vis. Say. Univ., sec. at 210° F.	41.6	48.6	52.2	....	49.2	52.0	...	40.9	57.3	50.0	40.1	50.2
Penetration at 77° F.	15	16	25	...	16	26	...	17	20	14	15	14
Oil content, per cent by weight	0.38	0.23	0.46	0.46	0.54	0.24	0.29	0.46	0.45	0.30	0.48	0.41
Sealing strength	16	23	60	18	15	80	16	23	66	29	11	29
Tensile strength, lb./sq. in.	168	140	200	160	160	204	204	128	252	220	144	192

*Waxy raffinate. †Petrolatum melting point, A.S.T.M.

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analysis for its solvent content, and then placed in the previously cleaned mixing vessel where it is reslurried by stirring with an additional 0.75 to 1.0 volumes of fresh solvent. This secondary slurry is then filtered and the wax cake obtained filtered and washed on the filter as in the previous operation. A small sample of the wet cake is removed for analysis and the remainder is topped free of solvent under vacuum in the laboratory. After running a few preliminary tests to indicate the proper conditions which should be employed, the bulk of the recovered wax is then clay-treated to color and the finished material subjected to analysis for oil content and the desired physical tests. The data collected from a number of pilot-plant runs on raffinates and crude waxes from various sources are shown in Table 1. The analytical and inspection data on the waxes produced in these pilot-plant runs are shown in Table 2 along with similar data on waxes produced commercially by the new deoiling process.

Commercial Wax Plant

The commercial plant designed to utilize the new deoiling process is patterned as closely after the pilot plant as it is possible to do in converting a batch process to a continuous one. The plant was designed to process 500 bbl. per day of crude wax obtained by propane dewaxing of vacuum distillates which, on subsequent phenol extraction of the dewaxed filtrates, finish to S.A.E. 20 and 40-grade oils. Based on this feed rate and its average wax content the plant should produce from 20 to 25 tons per day of finished wax melting at either 145°-150° F. or 160°-165° F., depending upon which grade of wax is being processed. In actual operation, however, the plant has not yet attained this production, due to no fault in the process, but to the fact that up to the present time there has not been sufficient crude wax available from dewaxing operations to supply the plant at capacity rates.

A simplified flow sheet of the plant is shown in Fig. 1. From this drawing

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the lines showing the inert gas blanketing system used to decrease the loss of solvent are eliminated since they are not essential to the operation of the process and only complicate the tracing of the flow of materials through the plant. Looking at this flow sheet, it is seen that separate storage tanks are provided for the two grades of crude wax processed. These tanks are of 5,000 bbl. capacity and are provided with steam coils for maintaining the stored crude wax at a temperature above its melting point. A similar tank is provided for the storage of the methyl-ethyl-ketone solvent. The melted crude wax is pumped from storage to two banks of continuous double-pipe scraped chillers connected in series. Each chiller bank consists of ten 40-ft. lengths of 6-in. pipe jacketed by 8-in. pipe, and each chiller bank is supplied with a separate stream of cooling water which flows countercurrently to the crude wax charge. The water supply to the first chiller bank enters at a temperature of 85° F. and cools the wax which enters at a temperature of 150°-165° F. down to approximately 115°-120° F., at which temperature it passes to the second chiller bank which is supplied with cooling water entering at a temperature of 55° F. This second chiller bank is supplied with a manifold connecting to each of the chiller pipes through which solvent may be pumped into the chilling wax charge to reduce its consistency as needed in order to prevent undue pressure rise in the chiller and avoid twisting off the scraper shaft heads. Ordinarily, no addition of solvent is necessary at these points when processing the lower-melting-point crude wax, since it causes no difficulties due to undue thickening during chilling. However, a considerable volume of solvent, equivalent to about one-third to one-half that of the crude wax flow rate, is introduced into the last pass in this chiller bank in order to reduce the consistency of the chilled wax and lessen the pressure drop in the line carrying it to the primary mix tank. When processing the higher melting point crude wax it is necessary to add solvent to the crude wax in the chiller pass in which it reaches a temperature of 100°-105° F. Small amounts of solvent may be added at subsequent passes, but in any case the amount of solvent added in this manner is equivalent to no more than about 10 per cent of the crude wax flow rate. A further volume of solvent, sufficient to bring the total amount added up to from one-third to one-half that of the crude wax flow rate, is added to the chilled wax in the last chiller pass for the purpose of decreasing the pressure drop in the transfer line to the primary mix tank. The temperature of the crude wax leaving this second chiller bank is varied at times to produce products of the particular melting points required on large orders, but it ordinarily is in the range of 70°-75° F.

The primary mix tank, which the chilled wax and the solvent added at the chiller next enter, is a vertical vessel of 4 by 10 ft. in dimensions and is equipped with a motor-driven stirrer. Fresh solvent is pumped to this vessel at a rate sufficient to bring the total volume of solvent in the primary slurry up to 1.5 to 2.0 times that of the crude wax. The temperature of the solvent added is the same as that of the chilled crude wax charge.

The primary slurry is pumped to the feed tank of the primary filter. This filter is an Oliver continuous vacuum one which is totally enclosed in a pressure housing to prevent loss of solvent by evaporation. The filter drum is 10 by 16 ft. in size. At the present time, due to lack of sufficient crude wax feed for the design capacity of the plant, approximately one-third of the area of this filter is blanked off and is not in use. The primary slurry fed to the filter tank is filtered under from 3 to 5 in. of vacuum and the wax cake formed is washed under 20 to 25 in. of vacuum, using a volume of fresh solvent equivalent to 0.5 to 1 times that of the crude wax in the slurry being filtered.

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The filtrate and wash liquids are collected separately in order to be able to maintain different degrees of vacuum on the filtering and washing sections of the filter. The filtrate receiver is a horizontal vessel 2 by 7 ft. in dimension. In this vessel the filtrate is maintained at a constant level, the excess being pumped to the wash solvent receiver where it is mixed with the wash solvent. The wash solvent receiver is a horizontal vessel 6 by 12 ft. in dimension. From it the combined filtrate and wash solvent are pumped to the filtrate solvent recovery system, the operation of which will be discussed later.

The washed wax cake is discharged from the filter by means of the conventional gas blow and scraper bar. The discharged cake falls onto a scroll where it is slurried with an additional amount of fresh solvent equivalent to 0.5 to 1 times that of the crude wax being processed. As this thick mixture is discharged from the scroll it is picked up by a pump which transfers it to the secondary mix tank where it is diluted with additional solvent sufficient to amount to about 1.0 to 1.5 times that of the crude wax being processed. This secondary mix tank is a duplicate of the primary mix tank described above.

The secondary slurry is transferred by pump from the secondary mix tank to the feed tank of the secondary filter which is a smaller edition of the primary filter, the drum being only 8 ft. in diameter and 12 ft. long. The slurry is filtered under 3 to 5 in. of vacuum and the cake formed washed on the filter with an additional amount of fresh solvent equivalent to 0.5 to 1 times the volume of crude wax being processed.

The filtrate and wash solvent are collected separately as in the primary filtering operation and then combined before being pumped either to the solvent recovery system or being circulated back to the second chiller bank and primary mix tank to furnish solvent for the primary slurry. The lines for this recirculation are omitted from the flow sheet to avoid confusion. This recirculation of filtrate and wash solvent from the secondary filter lightens the load on the solvent recovery system and does not adversely affect the operation of the process in any way, since the total amount of oil and wax in solution in the combined streams is not over about 1 to 2 per cent by volume of the solvent present.

The wax cake is discharged from the secondary filter by conventional gas blow and scraper bar and falls onto a scroll where it is mixed with an amount of solvent equivalent to 0.5 to 1 times the volume of the crude wax being processed. This slurry is discharged from the scroll to a pump which transfers it to the deoiled wax slurry tank which feeds the wax stripper system.

The filtrate solvent recovery system and the wax stripper system are tied together through the crosscirculation of the wet solvent vapor streams; the water being introduced as steam in the stripping of the hot filtrate and wax bottoms.

The filtrate recovery system consists of a fired heater, a fractionating column 7 by 50 ft. in size, a condenser, a solvent reflux storage drum 8 by 10 ft. in dimension, and two packed columns 2 by 40 ft. in dimension, one of which is used to steam-strip the filtrate bottoms from the main column and the other to obtain a concentration of the solvent from the dilute water solutions obtained in the steam-stripping operations.

The wax stripper system consists of a fired heater, a main stripper column 4 by 33 ft. in size equipped with a flash drum, a wet solvent column, a salt drier column 4 by 10 ft. in size, and a combined wet solvent reflux drum and solvent-water separator 3 by 12 ft. in dimension.

In operation the combined filtrates and wash solvents from the filters are fed through a fired heater to the filtrate fractionating column at a point somewhat below its center. The optional method of operation whereby the combined filtrate and wash solvent from the secondary filter are recirculated to form the primary slurry is not shown by the flow sheet. The solvent taken overhead is condensed

"The life and soul of science is its practical application."
— Lord Kelvin

1796 — 1832
Nicholas Leonard Sadi Carnot, a French physicist, discovered important principles of thermodynamics, which led to an understanding of the law of conservation of energy.

Carnot announced in 1824 that the expenditure of a given amount of work would produce a definite quantity of heat. The determination of the mechanical equivalent of heat was solved by later scientists.

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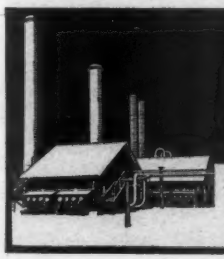

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and collected in the solvent reflux storage drum from which a portion of the material is circulated back to the column for reflux. The hot filtrate bottoms enters the packed stripper column approximately at its center and is stripped completely of solvent by steam which is introduced at the bottom of the column. The stripped bottoms, consisting of low-melting-point waxes and oil, is pumped to fuel-oil storage. The solvent vapor and steam overhead from this column is condensed and the condensate fed to the second packed column, used as a solvent-water fractionator, at a point somewhat above its center. At this point it is combined with a similar overhead stream from the wax stripper system. Steam enters the bottom of this column and strips the solvent from the water, thus producing a bottoms consisting of water containing less than 1 per cent of solvent, which is drawn to waste, and an overhead consisting of about 40 per cent of methyl ethyl ketone and 60 per cent of water. The overhead is condensed and pumped to the salt drier in the wax stripper system.

The slurry of deoiled wax and solvent is pumped from the deoiled wax slurry tank to the wax stripper column through a fired heater. The stream enters a flash drum in the top of the column and the solvent flashed overhead passes as vapor to the center of the neighboring wet solvent column. The bottoms from the flash drum flows downward through the stripper where it is stripped of solvent by steam introduced at the bottom of the column. The overhead mixture of solvent and steam passes, after being condensed, to the center of the solvent-water fractionator in the filtrate recovery system as described above. The overhead from the flash drum is mixed with wet solvent from the solvent-water separator as it enters the wet solvent column which is equipped with a steam reboiler. The overhead from this column is the azeotrope of the solvent and water. The bottoms is dry solvent and is returned to the solvent reflux drum for reuse. The overhead is condensed and the stream then split; a portion of it going to the salt drier column and the remainder to the wet solvent reflux drum for recirculation to the top of the column. The combined streams of wet solvent from the overhead on this column and the overhead from the filtrate solvent recovery system pass through the salt drier column where the water in the solvent dissolves sufficient salt to cause a separation into two phases. This mixture flows to the solvent-water separator where it is settled. From this separator the lower liquid phase, consisting of a salt-water solution containing a small amount of solvent, is withdrawn and discarded, while the upper liquid phase, consisting of wet solvent, is returned to the wet solvent column as previously described.

The bottoms from the wax stripper, consisting of deoiled wax at a temperature of around 450° F., is pumped to the first clay mix tank which is fed continuously with Filtrol clay in an amount proportional to the flow rate of incoming wax stream. This tank is equipped with a high-speed stirrer to prevent the clay from settling and insure good contact of melted wax and clay. The mixture of wax and clay overflows from this tank to a second one of similar design to allow for sufficient contact time. The wax-clay mixture overflows from this tank to the precoat filter surge tank which is kept stirred to prevent the settling of the clay. From this tank the mixture is pumped to the feed tank of an Oliver continuous precoat vacuum filter 3 by 4 ft. in size. By means of this filter, precoated with Super-Cel, the clay is removed from the decolorized wax. The clay-treated product is then pumped from the wax receiver to a small steam stripper where it is deodorized before being pumped to the refined wax storage tank. As stated above, although purposely not shown on the flow sheet, the entire plant operations are conducted in a closed gas blanketing system to avoid loss

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of solvent and degradation of the color of the hot refined wax.

The refined wax is withdrawn from storage to the filling room where it either is filled into wooden barrels or slabbed and packed into cartons before shipment. Two slabbing machines of conventional design are used, the capacity of each machine being 120 slabs. The slabs produced are approximately 19 by 12 by 1½ in. in dimension and weigh approximately 10 lb. each. They are packaged in cartons, each carton holding 10 slabs.

The refined wax produced is sold under the tradename Aristowax and the typical characteristics of the two melting-point grades produced are shown in Table 2. The lower-melting-point product, Aristowax 145°-150° F. is obtained in a yield of about 25 to 27 per cent from the crude wax produced from the S.A.E. 20 distillate while the higher-melting-point product, Aristowax 160°-165° F. is obtained in a yield of 15 to 17 per cent in processing the crude wax from the S.A.E. 40 grade vacuum distillate.

An analysis of the flow sheet discussion reveals that in this process a maximum of 6.5 volumes of solvent based on the volume of the crude wax being deoiled is needed for the operation of the process, and of this amount the required portion of the 2.5 volumes used in the secondary filter operations may be recycled to form the primary slurry leaving only 4.5 volumes at the most to be recovered by the solvent recovery systems. It is evident that a process which is so economical in solvent requirements and which will handle successfully a large variety of crude waxy materials should stand a favorable chance in normal times of eventually becoming widely used. However, even with the present shortage of high-melting-point waxes, the present wartime situation with respect to the availability of construction materials renders it rather improbable that many new wax-deoiling plants will be built for some time. For that reason it is desired to point out two modifications of the process which offer distinct possibilities of being incorporated into existing refining operations without the necessity for extensive construction and which should result in the production of greater quantities of much needed wax and high-viscosity-index oil.

The first of these modifications should be of interest to refiners now producing the ordinary paraffin waxes melting up to about 138° F. by the conventional cold pressing and sweating procedure recently surveyed in detail by Ralph H. Espach.* In this combination of operations, waxy distillates, usually of less than 100 seconds Saybolt Universal viscosity at 100° F., are chilled to a temperature of about 20° F. in order to crystallize the wax and then filtered under high pressure to produce crude wax cakes which may contain up to 60 per cent of oil. The crude wax cakes produced are then melted and run to sweater pans where the wax is freed of oil and fractionated into different melting-point products by repeated resweatings of the fractions first produced.

Work in the laboratory has shown that if the chilled wax distillates are diluted before pressing with a small amount of the proper refrigerated solvent, the oil content of the crude wax obtained after stripping of the solvent is greatly reduced, the volume of the wax cake is correspondingly reduced with the result that the greater quantity of wax held in the filter lengthens the filter cycle, and the subsequent sweating operation is shortened with less loss of wax to the foots oil produced. The decreased volume of the drier wax cake produced permits the sweating operation to be conducted with the use of a smaller number of sweater pans.

A second important modification of the process enables it to be fitted into existing dewaxing plants processing waxy raffinates by methods employing mixed solvents such as methyl ethyl ketone and benzene. Using a

*Manufacture of Paraffin Wax From Petroleum, Bureau of Mines Bulletin, No. 388.

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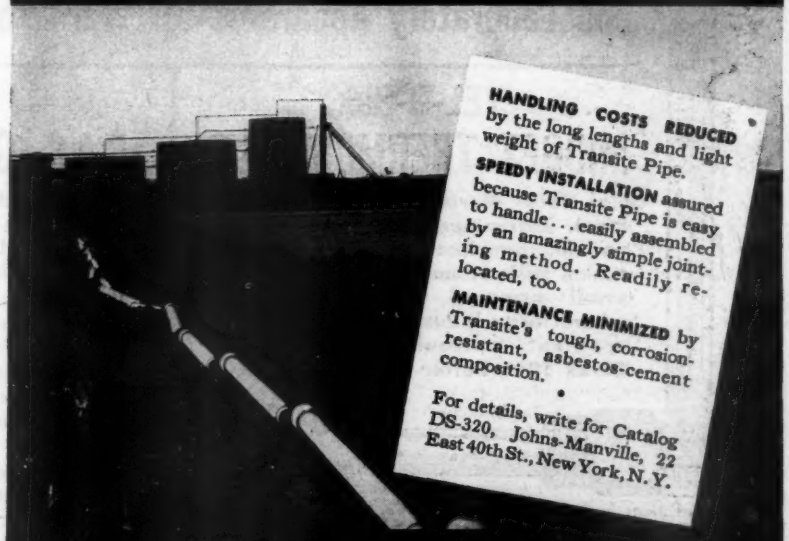
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combination of the two processes, the high-melting-point waxes in the raffinates may be recovered in an oil-free condition without increasing the solvent recovery load on the existing dewaxing-plant equipment, and at the same time decreasing the refrigerating load on the equipment and appreciably improving the yield of dewaxed oil obtained.

In this modification of the process the waxy raffinates, heated to a temperature sufficient to ensure all of the wax being dissolved in the oil, are chilled to a temperature in the range of about 55°-75° F., with constant stirring, in order to separate the high-melting-point wax in the desired crystalline condition. This thick slurry of wax crystals and raffinate oil is then mixed with the required amount of solvent at the same temperature as the chilled wax; the solvent being composed of a mixture of methyl ethyl ketone with a small amount of benzene to insure complete miscibility of the raffinate oil and dissolved low-melting-point waxes with the solvent. The slurry produced is then filtered and washed with fresh solvent. The washed wax cake is then reslurried by mixing with additional fresh solvent, at the same temperature as that previously introduced to form the primary slurry and the secondary slurry formed is then filtered and the wax cake obtained washed with additional fresh solvent. The wax cake from this operation is freed of solvent by distillation, and the residuum from this operation then clay treated for color to produce marketable deoiled wax. Examples of pilot-plant runs on waxy raffinates following this procedure are shown in Table 1, naphtha instead of benzene being used to modify the solvent properties of the methyl ethyl ketone.

Collect Solvents

The filtrates and wash solvents collected from this deoiling or partial dewaxing operation consist of a solution of all of the oil and low-melting-point waxes originally present in the raffinate. The solvents in which these components are dissolved are the same in nature as those used in the dewaxing process, but their proportions are not in the ratio required to prevent oil separation when the mixture is chilled to dewaxing temperature, and the volume ratio of solvent to oil is not high enough for dewaxing operations. Therefore, the next step is to increase the solvent-oil ratio and at the same time adjust the composition of the solvent to the desired dewaxing proportions of methyl ethyl ketone and benzene by adding more benzene. The additional benzene is added at approximately the same temperature as that of the combined filtrates and wash solvent, and the solution then chilled to dewaxing temperatures and the separation of the wax and oil solution accomplished by filtration in the usual manner. The wax cake and filtrate obtained are then stripped of solvent to recover the low-melting-point oily wax and the dewaxed oil. A solvent recovery method which can be utilized with little alteration of existing recovery systems has been developed in our laboratory to permit separation of the recovered solvent into two fractions; one of which is a mixture of methyl ethyl ketone and benzene in the proportions required for recirculation to the initial deoiling or partial dewaxing step in the process, and the other being high in benzene content and suitable for use in enriching the filtrates and wash solvents from the deoiling step to produce the dewaxing solvent.

Using this modification of the process, the total volume of solvent used in the combined deoiling and dewaxing operations is no greater than that required for the dewaxing process as it is usually operated.

Also, since the waxy raffinate is not crystallized from solution in the hot solvent, the solvent introduced being added to the precrystallized wax-oil mixture at around atmospheric temperature, the refrigeration costs of the combined processes are less than those of the conventional dewaxing process alone.

One other important result of this method of operation is that by it an appreciable increase in yield of dewaxed oils is obtained over that resulting from conventional dewaxing

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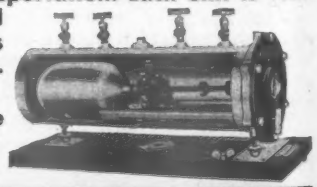

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operations. The reason for this is very simple.

When the waxy raffinate is dewaxed in a single-stage operation by conventional methyl ethyl ketone-benzene dewaxing process the wax cake obtained contains all of the wax originally present. In the combination of this process with the new deoiling process, the high-melting-point wax is removed in the first-stage deoiling or partial dewaxing operation, and all of the low-melting-point wax and oil is saved for the subsequent dewaxing operation in the second-stage operation. The amount of high-melting-point wax removed in the deoiling stage is equivalent to about 50 per cent of the total wax present in the waxy raffinate. Therefore, in the second-stage dewaxing operation the volume of the wax cake obtained is only about one-half that obtained from the single-stage dewaxing of the whole waxy raffinate. The reduced volume of wax cake obtained from the two-stage operation may be filtered to the same oil content as the larger volume cake obtained in the single-stage dewaxing operation. Therefore, since the yield of oil obtained from dewaxing operations depends upon the amount of oil left in the wax cake, it is evident that, other things being equal, the process producing the wax cake of least volume will give the largest yield of oil. Experiments show that in working with a waxy raffinate normally giving a 69.2 per cent yield of dewaxed oil by the single-stage solvent dewaxing process, an oil yield of 74.6 per cent could be obtained as the result of preliminary deoiling before complete dewaxing by the two-stage process described. The lower the normal yield of oil by the single-stage dewaxing process, the larger will be the increase in yield obtained from the two-stage combination of the new deoiling method and the conventional dewaxing process.

When due consideration is given to the fact that both the increased oil yield and the high-melting-point wax produced are obtainable at no increase in operating cost over that of the single-stage dewaxing process, the combined two-stage operation described is seen to be well worth complete investigation.

The author takes pleasure in expressing his thanks for permission to publish this article to D. E. Carr, manager of research for Union Oil Co. of California, whose constant encouragement has aided greatly in the development of the process described. Thanks are due also to Basil Hopper, manager of manufacturing, and to Homer Reed, W. E. Grebe and P. M. Huemmer, of the process development group, for their interest and time spent in ironing out the initial operating difficulties which resulted in successful operation of the commercial plant.

No Mumbo Jumbo about High Pressure, High Temperature Piping

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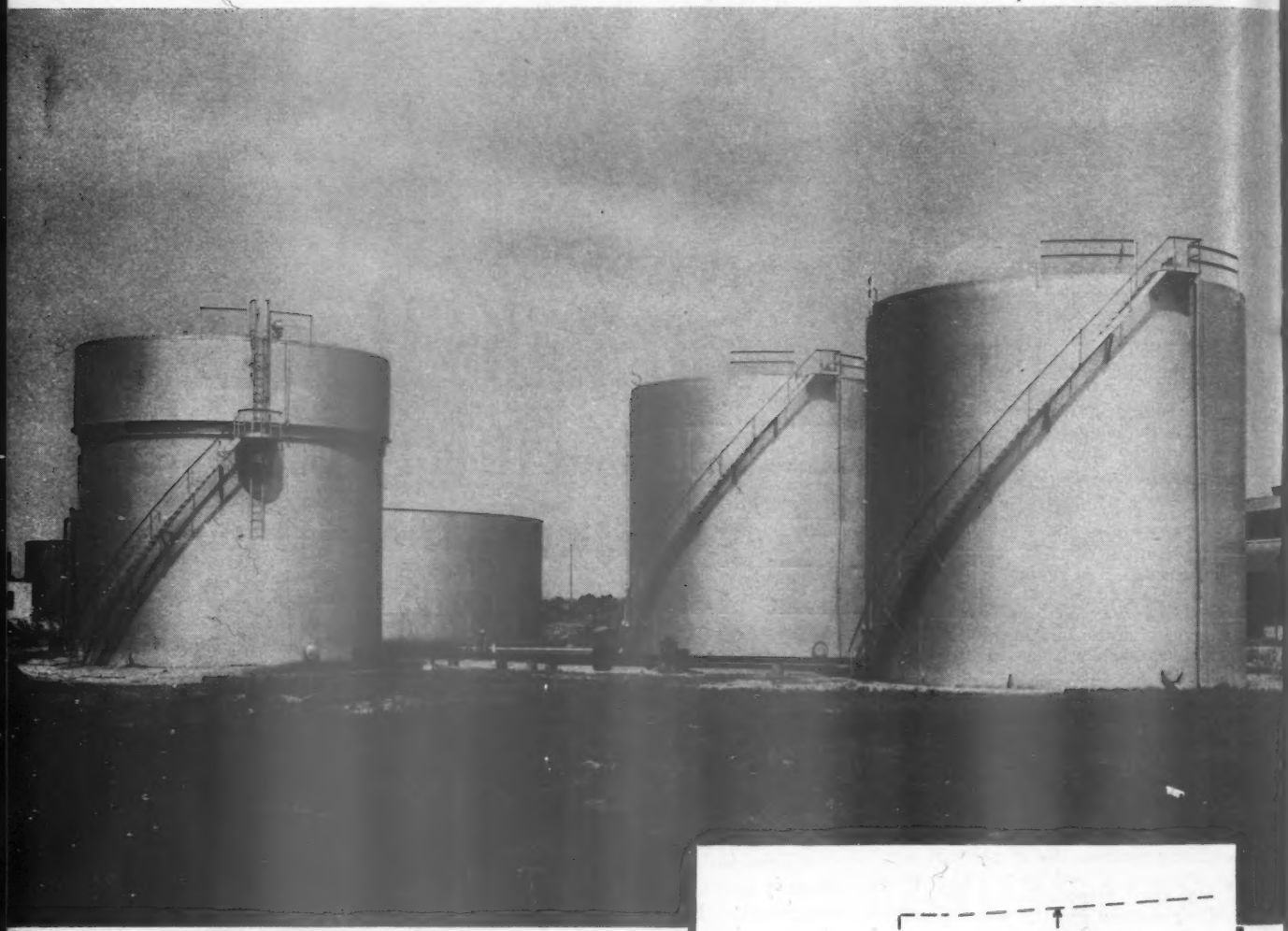
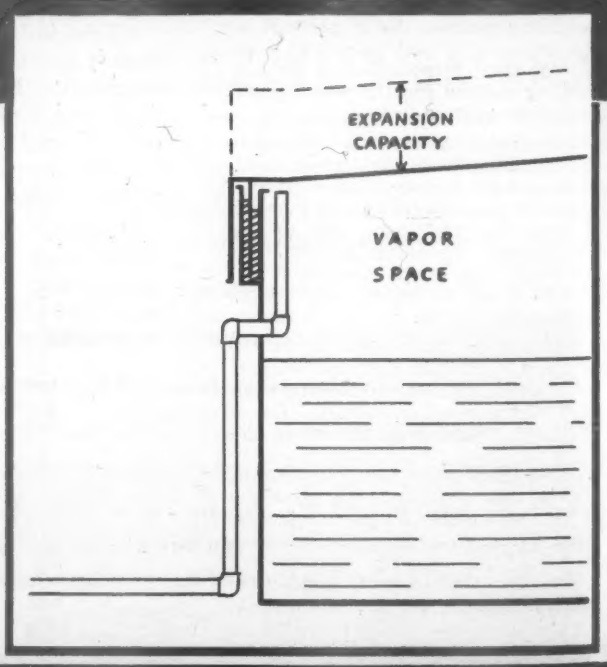


The photograph above shows a typical installation. Cone roof tanks are manifolded to the Graver Expansion Roof tank which provides absolute protection against vapor loss for the entire battery.

The accompanying diagram illustrates the operation of the Graver Expansion Roof. As vapors expand or contract, the roof rises or falls and, being liquid sealed all around, it holds the vapors instead of expelling them.

All equalizing equipment is inside, protected against the weather, but adjustments can be made from outside without taking tank out of service. There is no breathing in of moisture laden air and the conical shape of the roof prevents accumulation of snow and water.



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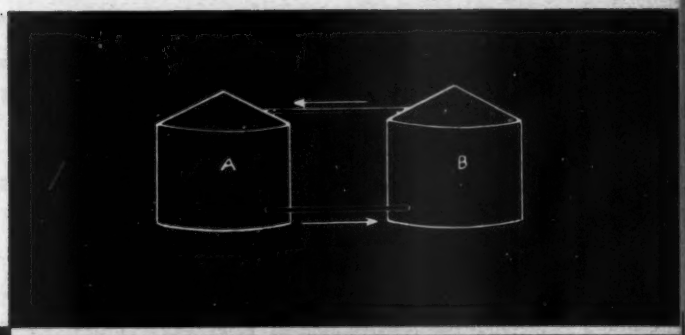
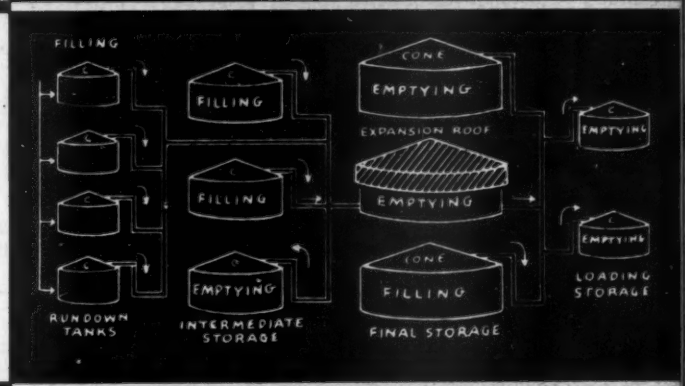
Roof Stops FILLING AND BREATHING LOSSES

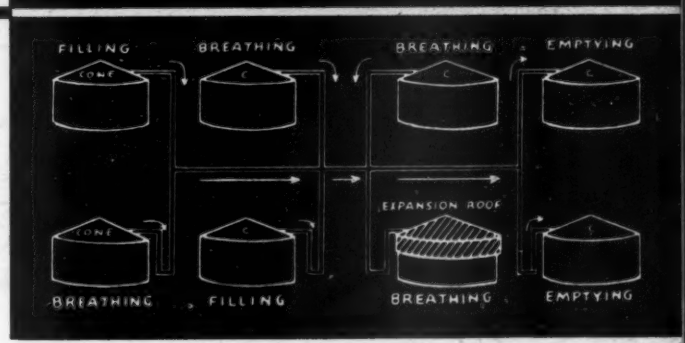
Theoretically, a simple hook-up, as illustrated at the right, would stop filling losses. If 1000 cubic feet of gasoline were pumped from A to B, 1000 cubic feet of vapor would pass from B to A. With all tanks at a refinery thus manifolded together, and with the same volume of products shipped as crude received, there would be no filling loss. But that, of course, is based on the assumption that there would be no change in temperature.



However, the daily difference between volume received and shipped, as well as breathing caused by changes in temperature, must be taken care of. The diagram at the right shows how, in a typical refinery unit, all vapor losses will be stopped by equipping only a few of the tanks with Graver Expansion Roofs. With the vapor spaces of the cone roof tanks manifolded to the Graver Expansion Roof tanks, all variations in volume and temperature are compensated for by the automatic rising or falling of the Graver Expansion Roof.



This same simple method applies with equal efficiency to terminal operations. Here, as a rule, only one Graver Expansion Roof tank is required, as shown by the accompanying diagram. The vapor spaces of the ordinary cone roof tanks are manifolded together and to the Graver Expansion Roof tank which retains all of the excess vapors forced out of the cone roof tanks by variations in volume or temperature.



Here is, without question, a profitable investment. With a single Graver Expansion Roof providing dependable protection for an entire battery of cone roof tanks you can depend upon economical, trouble-free service for years to come. The enormous savings in gallonage alone will pay for the entire installation within a short time, and will continue to return big dividends year after year.

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A Study of Gasoline

EVAPORATION LOSSES

by John Happel and D. P. Heath *

PRESENT transportation difficulties have made the conservation of gasoline in certain areas imperative. Since the construction of new tankage is impossible, this conservation is entirely a maintenance problem. The importance of maintenance in the conservation of gasoline in storage has not been generally realized. An up-to-date tank-maintenance program consisting of frequent inspection of the tank shell, valves, lines, venting and gaging equipment for liquid and vapor leaks has been found to reduce storage losses 50 per cent.

There are two general methods by which loss occurs from storage tanks. One is by the leakage of liquid product through valves, lines, and seams. The other is by the loss of vapor from the tank through vents and leaks in the tank roof. This article is primarily concerned with the second type, or evaporation loss. The change in volume of product with temperature will not be discussed as this is only an apparent loss. The importance of evaporation losses from a financial standpoint is easily seen when their extent is realized. An 80,000-bbl. cone-roof tank having four turnovers of product per year will lose about 2,000 bbl. of gasoline per year by evaporation. Under the same conditions an 80,000-bbl. pontoon-roof tank would lose about 350 bbl.

Evaporation losses represent quality as well as product losses, as vapor pressure, volatility, and octane number of the fuel are also lowered. It has been found that a 1 per cent volumetric loss from motor gasoline causes the A.S.T.M. 10 per cent point to rise about 5° F., the Reid vapor pressure to drop about 0.8 lb. per sq. in., and the A.S.T.M. octane number to drop about one unit.

Variables

The rate of evaporation loss from any given tank is affected by a number of variables including the following:

1. Average atmospheric temperature.
2. Daily temperature variation.
3. Color and condition of paint on tank.
4. Condition of tank and venting equipment.
5. Average wind velocity.
6. Vapor pressure of the gasoline.
7. Number of turnovers of gasoline in a given time.
8. Average product inventory.

Evaporation losses from crude or other petroleum storage tanks is a costly matter, losses from cone-roof tanks amounting to 1½ per cent per year, which may be reduced to ¼ per cent annually with a pontoon-roof tank. Precision construction and maintenance are required to eliminate most losses even from balloon-roof and similar tanks.

Types of Tanks

The relative importance of these factors depends somewhat on the type of tank used. Four general types of storage tanks will be considered:

1. Vertical cylindrical tanks with fixed roofs.
2. Vertical cylindrical tanks with variable roofs.

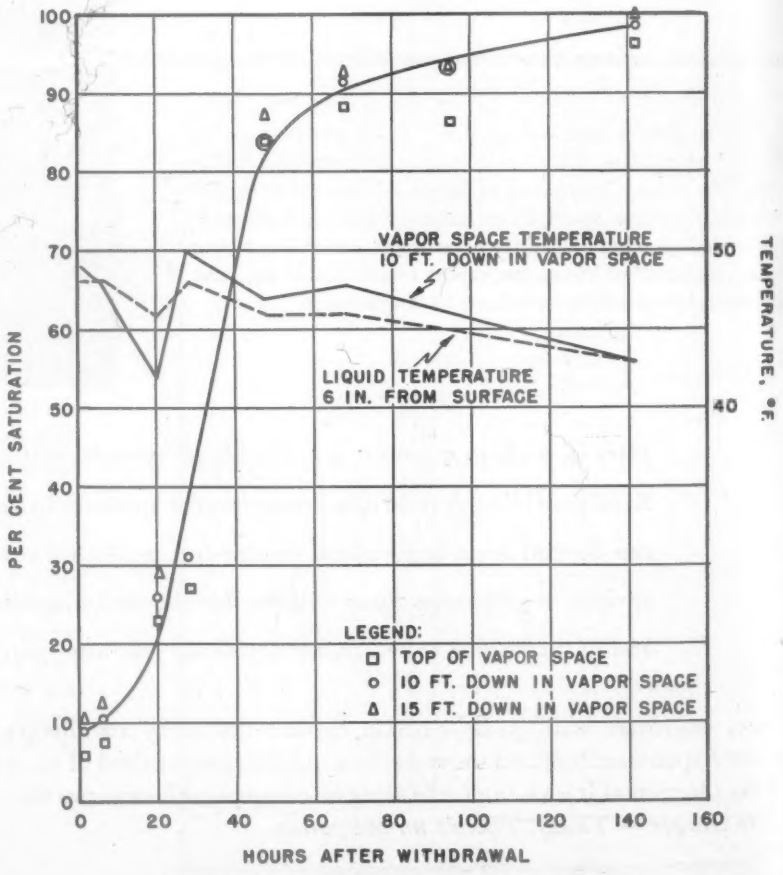

Fig. 1—Rate of saturation in storage-tank vapor space

*General Laboratories, Socony-Vacuum Oil Co., Inc., Brooklyn, N. Y.

3. Pressure storage tanks.
4. Floating roof tanks.

Fixed-roof tanks are more commonly known as cone-roof tanks. Because of the type of construction this type cannot stand any appreciable pressure. For this reason they are equipped with vents that open at about 1 oz. of pressure or vacuum per square inch.

There are two types of construction of tanks with variable roofs. One is the gasometer type where the roof construction is similar to that of a low-pressure gas holder except that it has a movement of about 4 to 8 ft. The other type construction uses a flexible steel diaphragm for a roof. When this diaphragm is the same diameter as the tank shell, it is called a breather roof. When it is a larger diameter it is called a balloon roof.

Pressure storage vessels for gasoline are usually Hortonspheroids, hemispheroids, or reinforced cone-roof tanks. A Hortonspheroid has a mushroom shape that is supposed to make the most efficient use of steel for pressure storage. A hemispheroid is a vertical cylindrical tank having a spherical segment or noded shaped roof. For motor-gasoline storage these tanks are usually built to withstand 2.5 lb. per sq. in. internal pressure.

Floating-roof tanks have a roof of sufficient buoyancy to float on the stored product. Steel shoes are suspended from the roof and are held against the tank shell by springs. The space between the roof proper and the shoes is covered by a flexible fabric sealing material. Frequently a loop of sealing material is fastened to the top of the shoes forming a secondary seal between the shoe and the tank shell.

Two types of construction are used to obtain a buoyant roof. One type has pontoons around the edge of the roof and the other type has a high rim like a pan. The pan type of construction, however, is not very common.

Mechanism of Evaporation Loss

Evaporation losses occur by two mechanisms from cone-roof tanks, breathing and filling. Breathing is the expansion and contraction of the vapor in the tank caused by the daily temperature variation. As the temperature of vapor drops at night air is drawn into the tank, and when the temperature rises during the day, air containing gasoline is expelled from the tank. Equations for the calculation of breathing losses can be derived, but a means of evaluating the rate of saturation of the vapor and the surface temperature of the liquid are necessary. Rogers[6] has developed such a method using a correction factor to correct the theoretical amount of gasoline in the vented vapor. The disadvantages of methods of this type are that extensive data are needed on the vapor space and liquid temperatures. An actual evaporation test can be made with the same amount of time and effort. Ashley,[1] Case,[2] Larson,[5] and Schmitt and Wilhelm[7] have published the results of actual tests.

As gasoline is withdrawn from a cone-roof tank, air is drawn into the vapor space, and during filling air saturated with gasoline vapor is expelled from the tank. The normal operation of a cone-roof tank at a bulk plant is to make a number of small withdrawals for each large fill. If the rate of saturation is low a volume of air equal to the volume of withdrawal will be drawn in and then saturated. If V_1 is the volume of the withdrawal the volume of saturated vapor V_2 is then,

$$V_2 = V_1 \frac{A}{A-W} \qquad (1)$$

where,

A = atmospheric pressure, lb. per sq. in.
W = vapor pressure at surface temperature, lb. per sq. in.

The amount of gasoline contained in this amount of vapor is then

$$G = V_1 \frac{A}{A-W} \times \frac{W}{A} \times \frac{1}{7.5\times 30} \times \frac{520}{T} \qquad (2)$$

which reduces to,

$$G = \frac{V_1}{7.5\times 30} \frac{W}{A-W} \times \frac{520}{T} \qquad (3)$$

where,

G = gasoline evaporated, gallons.
T = temperature of vapor, °F. abs.

In Equation 3 the factor 30 is to convert cubic feet of gasoline vapor to gallons of liquid, and the factor 7.5 is to convert gallons of withdrawal to cubic feet.

In most cases data on the surface and the vapor-space temperatures will be lacking. An inspection of Equation 3 shows that if the vapor pressure at tank temperature is used instead of the vapor pressure at the surface temperature of the liquid and the 520/T term omitted, the two errors brought about will tend to compensate. Tests have shown that for almost all cases this compensation effect is sufficient to allow the use of the approximate form of Equation 3 which is as follows:

$$G = \frac{V}{7.5\times 30} \times \frac{P}{A-P} \qquad (4)$$

where,

P = vapor pressure at liquid temperature, lb. per sq. in.

Since in the derivation of Equation 3 it was assumed that the rate of saturation was low, a test was made to determine the actual saturation time. A small cone-roof tank was pumped out quickly from nearly full to almost empty. The per cent saturation was determined by orsat analysis of the vapor and from the temperature of the liquid within 6 in. of the surface. Actual data taken during this test are given in Table 1. The results as plotted in Fig. 1 show that the rate of saturation is low enough to justify the assumptions made in deriving Equations 3 and 4. Coleman and Lewis[4] give a complete discussion of the assumptions and variables involved in the derivation of this type of equation.

TABLE 1
Test to Determine Rate of Saturation

Size of tank	25 by 25 ft.
Equipment	4-in. Oceco vent and 6-in. oil seal
Condition	Tank apparently vapor-tight. Top painted white and sides painted gray
Original innage	23 ft. 5 in.
Final innage	5 ft. 1⅞ in.
Grav. of prod.	70.8° A.P.I.
Reid vapor press., start of test	11.2 lb. per sq. in.
Reid vapor press., end of test	10.9 lb. per sq. in.

When the vapor space of a tank having a variable roof contracts at night the roof moves to its lowest point of travel before air is admitted to the tank, and when the vapor space expands in the daytime the roof rises to its maximum volume before any vapor is expelled. Thus, if sufficient variation in the vapor-space volume is provided, no vapor will be lost from the tank during standing storage. Larson[5] gives a chart for determining the variable volume of vapor space required to prevent all breathing. In general the balloon or gasometer-roof types will prevent all breathing from motor-gasoline storage, and the breather-roof type will prevent breathing from motor gasoline when it is over two-thirds full.

The roofs of variable vapor-space tanks also have sufficient capacity to prevent breathing after a normal withdrawal. For this reason a variable-roof tank has a lower withdrawal loss than a cone-roof tank, as a withdrawal from a cone-roof tank, in effect, causes an extra breathing cycle. If it is assumed that only enough gasoline is evaporated to saturate the additional vapor space caused by the withdrawal, the following formula for withdrawal loss can be derived in the same manner as Equation 4:

$$G = \frac{V}{7.5\times 30} \times \frac{W}{A} \qquad (5)$$

When the temperature of the vapor space of a pressure storage tank rises, the pressure increases. If the venting pressure is sufficiently high, no breathing will take place.

If the tank is at atmospheric pres-

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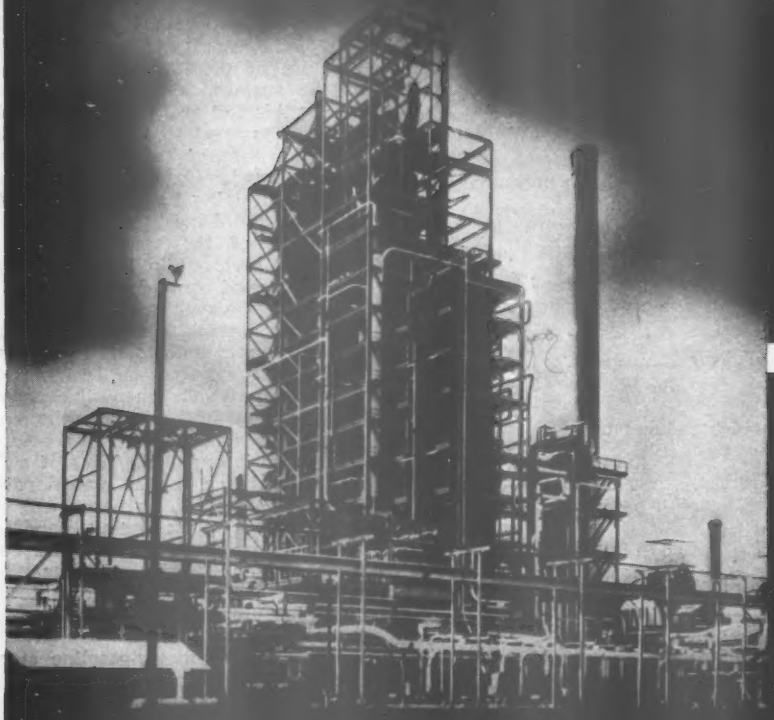

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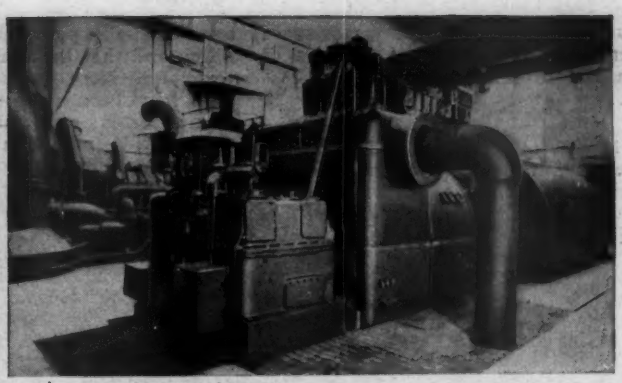

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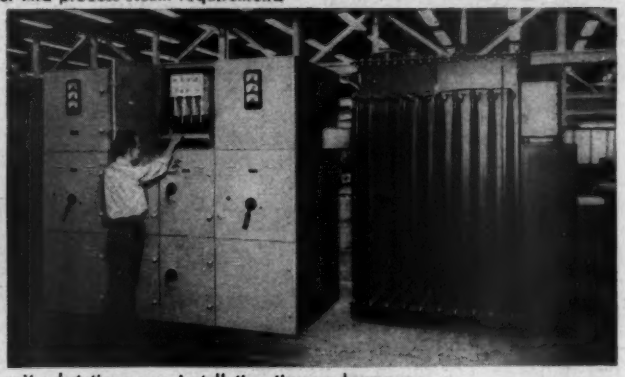

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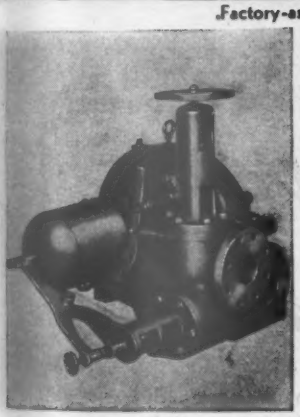

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sure at the minimum vapor-space temperature, the partial pressure of the air in the tank is

$$P = 14.7 - W$$

where W is the vapor pressure of the gasoline at that time. When the maximum vapor space temperature is reached the partial pressure of the air is

$$P = (14.7 - W)\frac{T_1}{T}$$

and the total tank pressure is

$$S.P. = (14.7 - W)\frac{T_1}{T} + W_1 \quad (6)$$

where,

S.P. = maximum storage pressure, lb. per sq. in.
W_1 = vapor pressure of the liquid at maximum temperature conditions, lb. per sq. in.
T_1 = maximum vapor space temperature, °F. abs.
T = minimum vapor space temperature, °F. abs.

Equation 6 can be used to calculate the maximum storage pressure required to prevent breathing. For motor-gasoline storage a storage pressure of 2.5 lb. per sq. in. is usually sufficient.

It is extremely important that the venting equipment of a pressure storage tank be in perfect operating condition and that the tank shell be entirely free from pin holes. Calculations have been made that show that 23 gal. per day of gasoline can be lost through a ⅛-in. hole in a tank having an internal pressure of 1.5 lb. per sq. in. gage and a vapor pressure of gasoline at the surface temperature of 4.0 lb. per sq. in.

When a withdrawal is made from a pressure storage tank enough gasoline evaporates to saturate the additional vapor space. This loss can be calculated by Equation 5. However, when a pressure storage tank is filled some of the gasoline in the vapor condenses. At the start of the filling operation the volume of gasoline vapor in the tank corrected to atmospheric pressure and 60° F. is

$$O \times \frac{W}{P} \times \frac{P}{14.7} \times \frac{520}{T}$$

where,

O = volume of tank vapor space, cu. ft.
P = tank pressure at start of filling, lb. per sq. in.
T = temperature of vapor space, °F. abs.
W = vapor pressure of gasoline at surface temperature, lb. per sq. in.

If the subscript "v" is used to denote conditions at the time venting starts, the volume of gasoline vapor at venting is

$$O_v \times \frac{W_v}{P_v} \times \frac{P_v}{14.7} \times \frac{520}{T_v}$$

By subtracting these two expressions the following formula for the amount of gasoline condensed during filling is obtained:

$$\text{Saving} = \left(\frac{OW}{T} - \frac{O_v W_v}{T_v}\right)\frac{520}{14.7} \quad (7)$$

The volume of the vapor space at which venting starts can be determined from the partial pressure of the air in the tank as follows:

$$V_v = V\left(\frac{P - W}{P_v - W_v}\right)\frac{T_v}{T}$$

If this expression is substituted in Equation 7 the following formula is obtained:

$$\text{Saving} = \frac{O}{T}\left[W - W_v\left(\frac{P - W}{P_v - W_v}\right)\right]\frac{520}{14.7} \quad (8)$$

The maximum filling loss would occur when P = P_v and would be

$$\text{Max. loss} = F \times \frac{W}{P} \times \frac{P}{14.7} \times \frac{520}{T} \quad (9)$$

Fig. 170
400-lb. Test

Fig. 192
1600-lb. Test

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where,

F = volume of fill, cu. ft.

Equation 9 is merely another form of Equation 5. The percentage of maximum loss that actually occurs is then,

$$\% \text{ max. loss} = \frac{\text{Max. loss} - \text{savings}}{\text{Max. loss}} \times 100$$

By substituting Equations 8 and 9 in this expression and simplifying the following formula is obtained:

$$\% \text{ max. loss} = \left[1 - \frac{O}{FW}(W - W_v\frac{P-W}{P_v-W_v})\right] 100 \quad (10)$$

Actual tests have shown that the heat of compression in filling a pressure storage tank is not sufficient to appreciably raise the liquid surface temperature. The vapor pressure of the gasoline, then, remains constant during pumping and Equation 10 can be simplified to,

$$\% \text{ max. loss} = \left[1 - \frac{V}{F}(1 - \frac{P-W}{P_v-W})\right]100 \quad (11)$$

Actual filling tests on spheroids have substantiated Equation 11. Under normal bulk plant operating conditions the actual filling loss has been about 60 per cent of the maximum.

Since floating-roof tanks have no vapor space, they have no breathing or filling losses. However, losses do occur by the escape of gasoline vapor between the shoes and the tank shell and by capillary action which causes gasoline to climb up the rough tank wall past the shoes and secondary seal. This loss caused by capillary action is small compared to the losses of vapor past the seal.

Methods of Testing

Because of the large number of variables involved actual evaporation tests must be made to determine average rates of evaporation loss. The four possible methods of measuring these losses are as follows:

1. Gaging.
2. Metering of vented vapor.
3. Adsorption of vented vapor.
4. Chenicek and Whitman method.

Gaging methods will not give accurately reproducible results on individual tanks because of the small volumes involved and the difficulty of obtaining an accurate average temperature of the liquid body. However, over a long period of time gaging will give accurate average loss rates if applied to a large number of tanks.

The metering of the amount of vapor vented from a tank is difficult in that there may be small leaks in the tank roof that cannot be measured. Secondly, the percentage of gasoline in the vented vapor is not readily determined.

Gasoline can be quantitatively absorbed from saturated vapor by charcoal, but again it is difficult to collect all of the vapor.

The most widely used method of determining evaporation loss is that of Chenicek and Whitman.[3] In this method samples taken at the beginning and at the end of the test period are analyzed in a special apparatus to obtain curves of per cent evaporated versus vapor pressure. When these curves are plotted on semilogarithmic paper two parallel straight lines are obtained. The distance between these lines represents the per cent evaporated. The accuracy of this method of determining losses depends to a certain extent upon the product stored. A product such as crude oil that has a rapid change of vapor pressure with per cent evaporated will give more accurate results than aviation gasoline which has a small change of vapor pressure with evaporation. With motor gasolines results accurate to ±0.05 per cent can be obtained.

The Chenicek and Whitman method gives a measure of all the losses occurring by evaporation from the liquid state. However, it does have certain limitations. Tests cannot be made when a pure compound is

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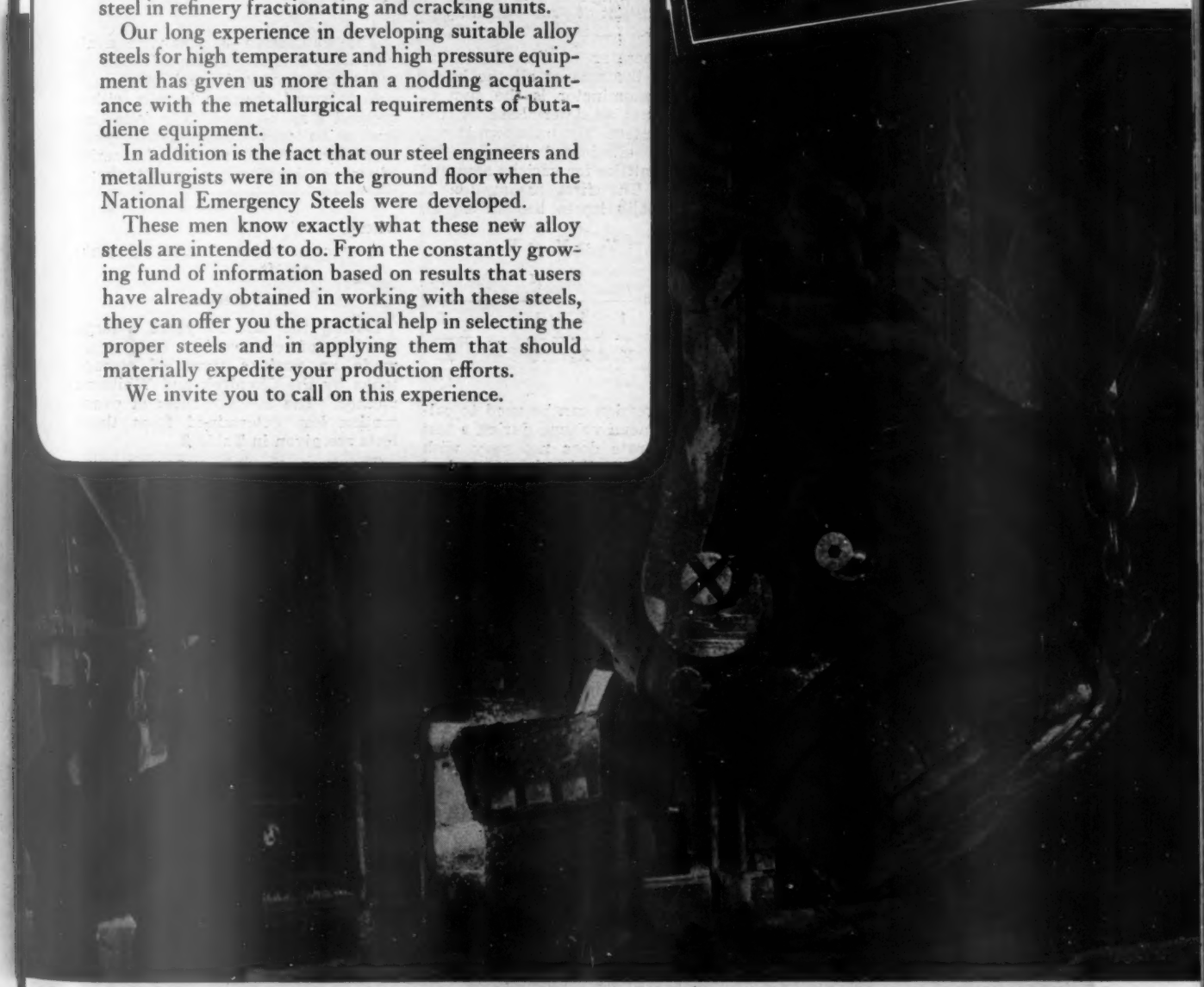

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stored. The tank under test must not be filled during the test period although withdrawals can be made. And the length of the test period should be such that a loss of 0.2 per cent or larger will occur. For conservation type tanks this may require from 4 to 6 months.

Calculation of Test Results

The percentage evaporated by the Chenicek and Whitman method applies to the amount of gasoline remaining in the tank at the end of the test period. The percentage evaporated from gasoline that has been withdrawn during the test is less than that determined by the Chenicek and Whitman test. Thus, when withdrawals have been made, a mean volume of product must be used to obtain the total gallonage loss. In addition if the standing storage loss is to be calculated, the Chenicek and Whitman loss per cent must be corrected for the loss caused by each withdrawal. For each withdrawal made from a cone-roof tank the withdrawal loss is calculated from Equation 4, and the per cent loss determined on the volume remaining after the withdrawal. The sum of the withdrawal loss percentages is subtracted from the Chenicek and Whitman loss to obtain the per cent standing loss. For spheroid and balloon-roof tanks Equation 5 is applied in a similar manner.

Assuming that withdrawals take place periodically, that is, instantaneously at the end of each day, it is possible to derive several formulas for the mean tank volume to cover different sets of conditions. The general case is covered by:

$$X_m = \frac{Y_1 + Y_2 + Y_3 + \ldots + Y_n}{\frac{Y_1}{X_1} + \frac{Y_2}{X_2} + \frac{Y_3}{X_3} + \ldots + \frac{Y_n}{X_n}} \quad (12)$$

where,

X_m = mean volume of gasoline in tank during test, gallons

X_1, X_2, X_3 = volume of gasoline in the tank on successive days, gallons

Y_1, Y_2, Y_3 = evaporation loss on successive days, gallons

N = number of days of the test

The numerator of the above expression is the sum of all the losses and the denominator is the sum of the per cents as determined by the evaporation test. The unknown losses, Y_1 can be eliminated in terms of known quantities for various assumed conditions. The first assumption is that the daily losses are all equal, then

$$Y_1 = Y_2 = Y_3 = Y_n$$

$$\text{and } X_m = \frac{N}{\frac{1}{X_1} + \frac{1}{X_2} + \frac{1}{X_3} + \ldots + \frac{1}{X_n}} \quad (13)$$

This expression can be used to calculate the mean volume during a test where the rate does not vary with outage. This condition is approached when no breathing takes place; therefore, Equation 13 can be used to calculate the mean volume during a test on floating roof, variable roof, and pressure storage tanks.

When breathing does occur as in cone-roof tanks, it may be assumed that the evaporation loss increases with outage from a small constant loss at zero outage, then

$$Y_1 = a$$
$$Y_2 = a + k(X_1 - X_2)$$
$$Y_3 = a + k(X_1 - X_3)$$
$$Y_n = a + k(X_1 - X_n)$$

Substituting in Equation 12 and simplifying

$$X_m = \frac{\frac{Na}{k} + (N-1)X_1 - (X_2 + X_3 + \ldots + X_n)}{\frac{a}{k}\left(\frac{1}{X_1} + \frac{1}{X_2} + \ldots + \frac{1}{X_n}\right) + \frac{X_1 - X_2}{X_2} + \frac{X_1 - X_3}{X_3} + \ldots + \frac{X_1 - X_n}{X_n}} \quad (14)$$

where,

a = breathing loss at zero tank outage

k = constant of proportionality

The expression a/k can be evaluated theoretically or experimentally. Since the mean volume is not sensitive to small changes in a/k, either method may be used. The following expression was determined experimentally from the results of a series of tests on inactive cone-roof tanks:

$$a/k = 41.6\,A$$

where,

A = cross-sectional area of tank, sq. ft.

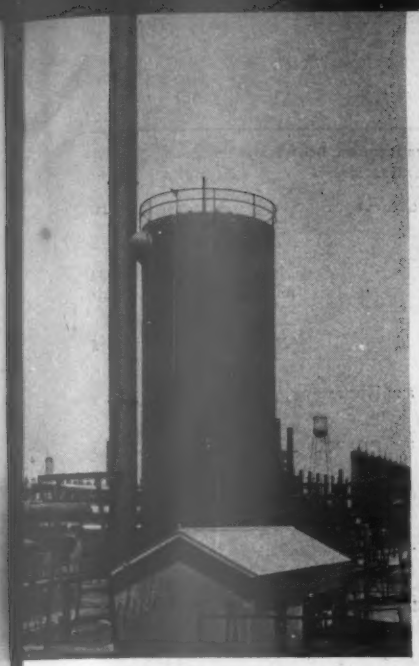
Test Results

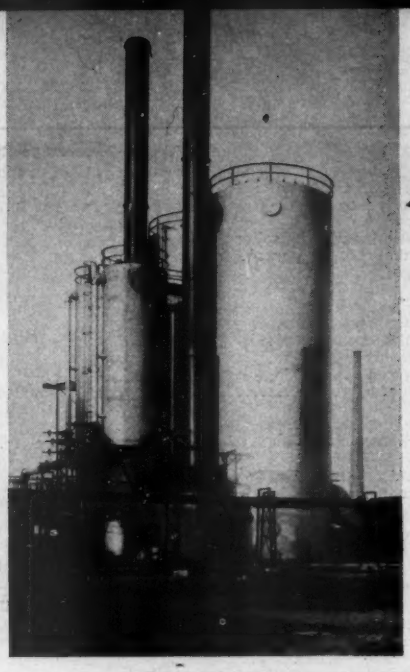
During the last 10 years a large number of evaporation tests were made on various types of storage tanks by the Chenicek and Whitman method. The average rates of evaporation loss determined from these tests are given in Table 2.

The term absolute vapor pressure used in the evaporation loss rates in Table 2 is the vapor pressure of the gasoline at the average liquid temperature. This value being more easily determined than the surface temperature.

(Continued on Page 174)

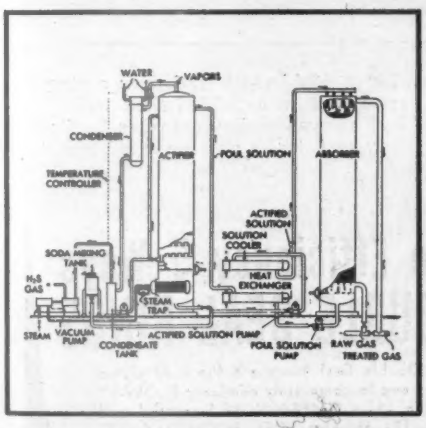
A vapor balloon, attached to a storage tank for reducing vapor losses in stored crude petroleum and refined products





Seaboard

These three plants use the Koppers Seaboard process. Gas passes upward through an absorber and is contacted with a continuous downward stream of sodium carbonate solution. Foul solution leaving the absorber is forced to the top of the actifier. As it flows down it is contacted in countercurrent with air which removes the H_2S. The solution is pumped back to the absorber.

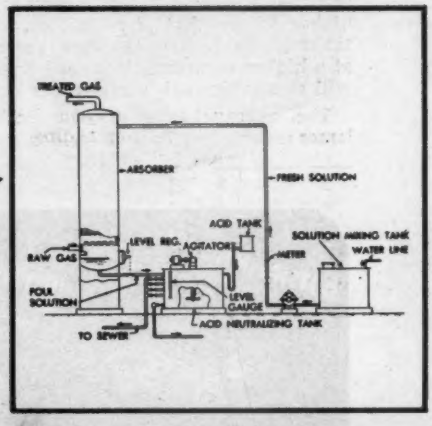


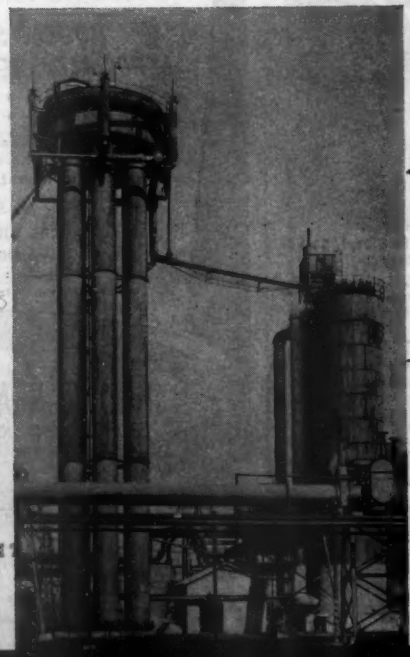
Hot Actification

The Hot Actification Process (patented) is extremely simple in operation. It uses a solution of sodium carbonate to remove the sulfur from the gas. This solution is steam stripped in a vacuum column.

Modified Thylox

In this process, the normal cyclic operation has been modified to purify hydrocarbon gases of low hydrogen sulfide content where substantially complete purification is desired. Raw gas is contacted with fresh Thylox solution in a bubble-cap absorber. The special solution passes to a tank where it is neutralized with acid and the precipitated arsenic sludge is allowed to settle before the clear water is discarded.





Purification for Liquid Hydrocarbons

The expense of the usual caustic treatment of various liquid hydrocarbons led to the development of this modification of the Seaboard process. Soda ash in water solution is used in a continuous, cyclic process. The solution is regenerated and re-used.

Thylox

In the Koppers Thylox process, gases are scrubbed with sodium thioarsenate solution in a counter-flow packed tower. Sulfur is obtained by actifying the foul solution in a thionizer, filtering off the sulfur and melting the filter cake in an autoclave.

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Table 2 includes average rates of evaporation losses for types of tanks that are generally believed to eliminate all evaporation losses. About half of these tanks actually showed no losses, but some of them had losses of over 50 gal. per day. It is not possible to prevent all losses from spheroids and balloon-roof tanks because of the precision construction and maintenance necessary to prevent all leaks, however, an adequate maintenance program has been found to cut these losses in half. Such a program should include periodic inspections of tank shell and venting and gaging equipment. Wherever ice conditions are encountered, vent valves having ice-breaking features should be used. All new pressure storage tanks should be tested for leaks along the seams with a strong soap solution while sufficient air is blown into the tank to maintain venting pressure. In addition, actual evaporation tests should be made every 2 or 3 years to make sure that no leaks have escaped detection.

The average rate of evaporation loss reported in Table 2 for spheroids is higher than that for balloon-roof tanks probably because they operate at a higher pressure, thus more vapor will escape through a given size hole.

The average rates of evaporation losses reported in Table 2 for pontoon-roof tanks are considerably higher than those reported by Larson.[6]

It is interesting to note that this series of tests showed no advantages for a double-seal roof over a single-seal roof on a welded shell tank.

The evaporation loss rates for floating-roof tanks are reported on the

TABLE 2—Average Evaporation Loss Rates

Type tank—	Average rate of evaporation loss	Remarks
Cone-roof tanks, conservation vents	1.0 gal./yr./sq. ft./lb. abs. vapor pressure	Average outage 10-15 ft.
Spheroid and hemispheroid tanks (2.5 lb. per sq. in. gage)	15 gal./day	60—100,000-bbl. spheroids and 10,000-bbl. hemispheroids
Balloon and gasometer-roof tanks	2.5 gal./day	3—80,000 bbl. tanks tested
Pontoon-roof tanks:		
Riveted shell single-seal roof	60 gal./yr./ft. diam./lb. abs. vapor pressure	
Riveted shell double-seal roof	31 gal./yr./ft. diam./lb. abs. vapor pressure	
Welded shell single-seal roof	23 gal./yr./ft. diam/lb. abs. vapor pressure	
Welded shell double-seal roof	23 gal./yr./ft. diam./lb. abs. vapor pressure	

TABLE 3—Rates of Filling Loss

Conditions:	
Average inventory	40% tank capacity
Average receipt	20% tank capacity
Vapor pressure at tank temperature	5.0 lb. per sq. in. abs.
Pressure in pressure storage tanks at start of filling	16.0 lb. per sq. in. abs.
Type of tank—	Calculated filling-loss rate
Cone-roof tank	0.22% throughput
Balloon and gasometer-roof tanks	0.15% throughput
Pressure storage tanks (2.5 lb. per sq. in. gage venting pressure)	0.10% throughput
Floating-roof tanks	None

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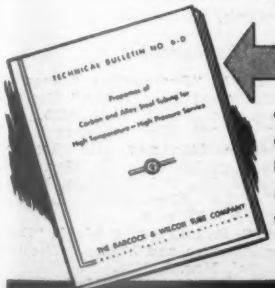

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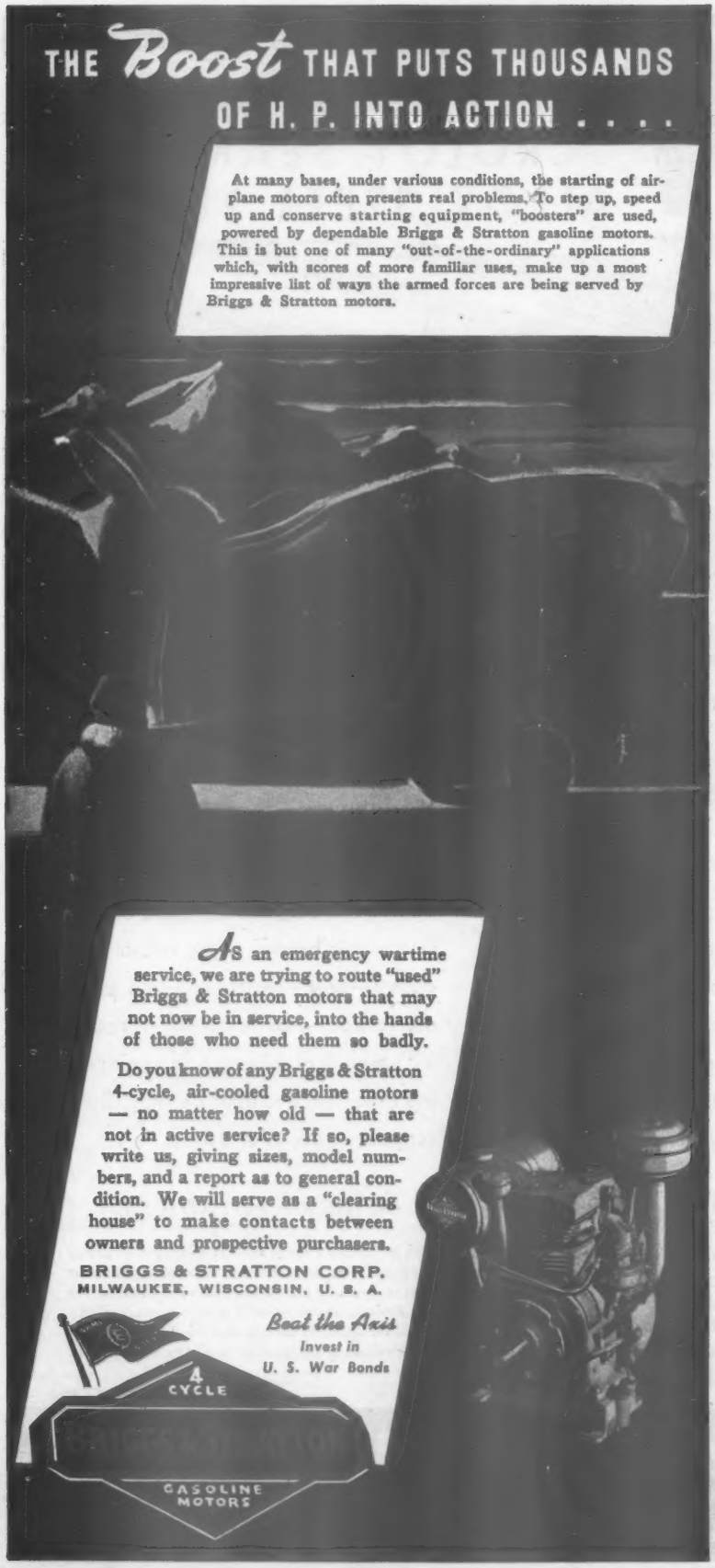
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basis of diameter, because it is directly proportional to the circumference. Since the loss occurs between the seal and the shell of the tank, the circumference is more of a controlling factor in the evaporation loss rate than the area.

The tanks tested to obtain the data for Table 2 were with few exceptions located in the East and Middle West.

Rates of filling losses vary too much with operating conditions for averages to be determined. However, tests have shown that they can be calculated by means of Equations 4, 5, and 11. The rates of filling loss for average bulk-plant operation as calculated from the equations are given in Table 3.

Economics

The data given in Table 2 together with the equations for filling losses can be used in conjunction with tank and maintenance costs to calculate the economics of installing the common types of tanks. The most economical tank will be the one having the lowest 10-year cost. Calculations of this type will generally show that wherever a tank is to be filled more than eight times per year a floating-roof tank will be the most economical. For extreme weather conditions where snow and ice-removal difficulties prevent the use of floating-roof tanks, spheroids are usually recommended for this high turnover. Where a tank is to be worked slowly a balloon-roof, gasometer-roof, or a pressure-type tank will be the most economical depending upon local conditions. Where low-vapor-pressure products such as kerosene and fuel oil are to be stored, losses are extremely small in any type tank, and cone-roof tanks are almost always used.

Acknowledgment

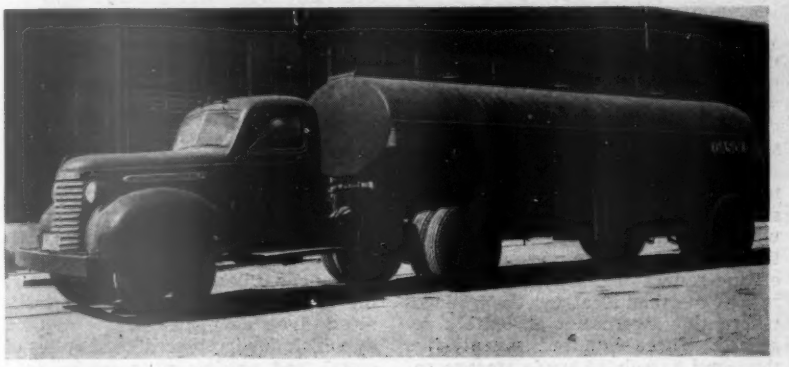
The authors wish to acknowledge the assistance received from employes of the general laboratories and the domestic trade division of Socony-Vacuum Oil Co., Inc. We wish to thank Dr. J. B. Rather and A. E. Esser in particular for making possible this work.

Bibliography

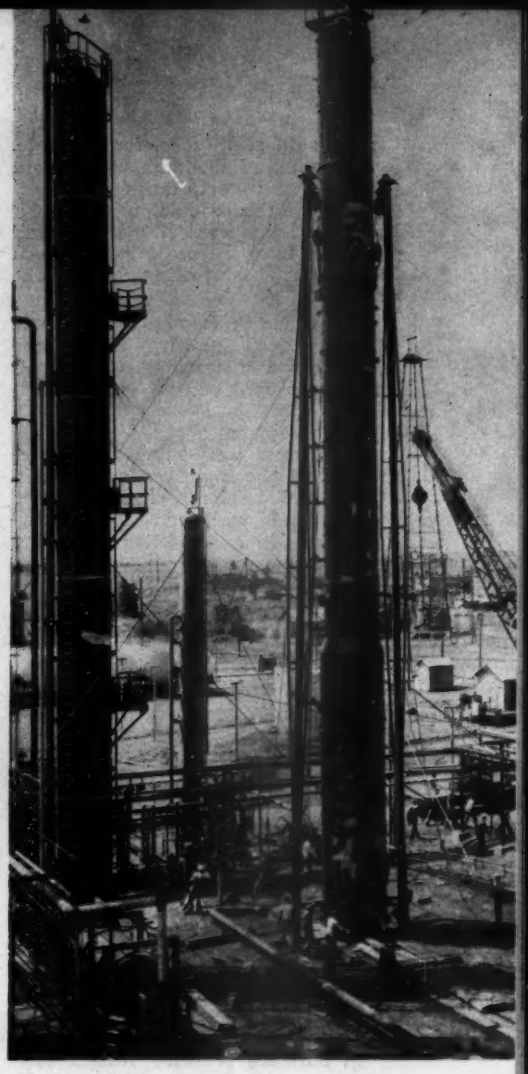
1. Ashley, C. C., "Evaporation Losses of Petroleum Oils From Steel Tanks," The Oil and Gas Journal, p. 170, Nov. 18, 1938.
2. Case, C. L., "Modern Equipment and Methods Reduce Handling and Storage Losses," Petroleum World, p. 52, Mar. 1932.
3. Chenicek, G. W., and Whitman, W. G., "Determination of Evaporation Losses," Proc. A.P.I., 2, No. 75, p. 4.
4. Coleman, S. P., and Lewis, W. K., "Correlate Vapor Pressure and Losses," The Oil and Gas Journal, Mar. 5, 1931.
5. Larson, D. E., "Practical Methods for Storing Volatile Liquids," Trans. A.I.Ch.E., 38, p. 1 (1942).
6. Rogers, W. F., "Method for Calculating Oil Evaporation Losses," Petroleum Engineer, 9, p. 39, June 1938.
7. Schmitt, Ludwig, and Wilhelm, C. J., "Reduction of Evaporation Losses From Gasoline Bulk-Storage Tanks," U. S. Bur. of Mines, R.I. 3135.

5,000 Tons of Steel Salvaged and Reclaimed By One Company

Collecting scrap from 30-ton chunks to small bits picked up by a magnet; building 75,000-lb. tower from old absorbers are some accomplishments of this conservation program



This truck and tank were assembled and rebuilt entirely from salvaged equipment



This fractionator was built by welding together two 6-ft. and one 7-ft. absorbers; only purchased part is the transition "cone" joining the 7 to the 6-ft. diameter in the lower part of the tower. Weight of tower, 75,000 lb.

by Arch L. Foster

COLLECTING and shipping more than 600,000 lb. of steel scrap during 8 months of 1942; reclaiming 3,200 tons of used equipment and putting it back to work; saving and revamping nearly 5 tons of pipe and tubes, and rebuilding 67,000 steel drums is something of a record, even in these emergency times. Yet that is the record set by one company—Phillips Petroleum Co.—during the 8-month period ending in November 1942. And the work is still going on.

These figures do not include many smaller separate items, all of which help materially to "keep 'em rolling" in this war period. Several tons of nonferrous metal scrap were also collected. Seven thousand feet of electrical conduit and 6,000 ft. of not-in-use wire were salvaged, more than a mile of each. Among the equipment items salvaged on one project alone, and made serviceable, or repaired and again placed in service, are 32,000 ft. of pipe of various sizes. Twelve thousand feet of still tubes were reclaimed, most of the tubes being chromemolybdenum. One hundred twenty-five 5 by 10 return bends were rebuilt; a complete fractionator was built by welding together two 6-ft. and one 7-ft. diameter absorbers, making a serviceable tower weighing 37½ tons. The total pipe revamped weighed more than 4,000 tons. The weight of the 67,000 reclaimed drums is not available, but 67,000 is a lot of drum capacity in any language.

The value of all this scrap and reclaimed material has been estimated at more than $3,500,000, according to A. H. Riney, chairman of Phillips conservation committee. The result was accomplished by cooperation of 10,000 company employes, scattered all over the company's operating territory, field, gasoline plants, refineries, pipe lines and products-distribution system.

Early in 1942 executives of the company, seeing the handwriting on the wall for equipment, worked out a meticulous and very comprehensive salvage and reclamation schedule and the battle was on. A complete transport tractor-trailer unit was built from parts and sections of other such units. Scrap was gathered from long-forgotten spots. An idea of the thoroughness of the plan is indicated by the installation of a large magnet, suspended beneath a truck and energized by a small welding generator, to pick up scrap metal along plant roadways, with the double purpose of collecting steel and removing objects which damage tires. Several barrels of scrap had thus been collected at the time of the last report. At one fell swoop 73,000 lb. of scrap was collected by consigning to the heap an old engine and vacuum pump cylinder.

In addition to supplying scrap to the mills for conversion to any needed products, probably the most important results of the program, from the standpoint of the immediate situation at least, are:

1. Saving of irreplaceable scarce al-

loys, as in still tubes, for example.

2. Saving of the manpower, plant capacity and operating supplies required for the production and distribution of less critical materials, all the way from the ore mines through the mills and fabricating plants to the point of use.

3. Increase in the productive capacity of the oil industry through the construction of new plants and facilities from used and reclaimed materials.

To save scarce alloys, for example, still furnaces were divided into sections and the lowest alloy steel in tubes and headers, etc., was used which would withstand the operating conditions in each section. The plan was:

Carbon steel up to 850° F. temperature.

2¼ per cent chrome steel for 850-1,150 metal temperature.

7 per cent chrome steel for 1,150-1,225 metal temperature.

18-8 chrome nickel for 1,250-1,600 metal temperature.

Installations subjected to high temperatures were studied, location of valves was changed to lower the valve working temperature and permit use of lower alloy metals. Admiralty tubes in exchangers, with thinner walls were used, reducing metal requirements. Alloy bubble caps in towers have been eliminated. Because of the scarcity of tin, old bearing metal is salvaged very carefully.

In building pressure vessels, towers, etc., gunite linings to prevent corrosion are used instead of 11-13 per cent chrome steel linings; enamel caps and risers for chrome steel in corrosive service; light-gage steel for bubble plates, caps, risers for chrome steel in noncorrosive locations. Carbon steel is used in all noncorrosive service instead of chrome and chrome-nickel steel in pumps, tubing and piping; cast-iron sleeves for brass in centrifugals; cast-iron bodies for valves instead of cast steel; Saran plastic tubing for copper and brass where required strength is low; lead-base for tin-base bearings. Wood and other nonmetals are applied widely in tankage and cooling towers; two 2,500-bbl. wood tanks used in place of one 5,000-bbl. steel tank; glass floats for metal in automatic tank batteries; wood redistribution system in cooling towers instead of brass and steel; tank supports of concrete rather than steel.

In constructing company houses and buildings plastics were used instead of metal for trim and hardware; wood sash and doors for metal in semihazardous locations; nonreinforced concrete for metal decks; felt in place of galvanized iron for covering insulation. Metal electric conduits have been omitted and salvaged, weatherproof or armored cable used.

When removing paraffin from lines rubber balls have been replaced by soluble plugs; transite pipe or concrete-lined pipe lasts longer than steel for handling salt water, and has been used. Retail containers for "bottled gas" are no longer galvanized, thus saving zinc. Drums with fiber walls and steel tops and bottoms were purchased, saving 13 tons of steel. The list in this manner can go on indefinitely, even to the smallest items. Here are some of the tricks used: gas-engine spark plugs connected to contact fences eliminate the use of batteries for keeping animals away from pump units. Wood fence posts are substituted for steel. One-color typewriter ribbons replace two-color, doubling the life of each ribbon. Lines to new bottle-gas customers have been changed from copper to steel.

Use of Stored Equipment

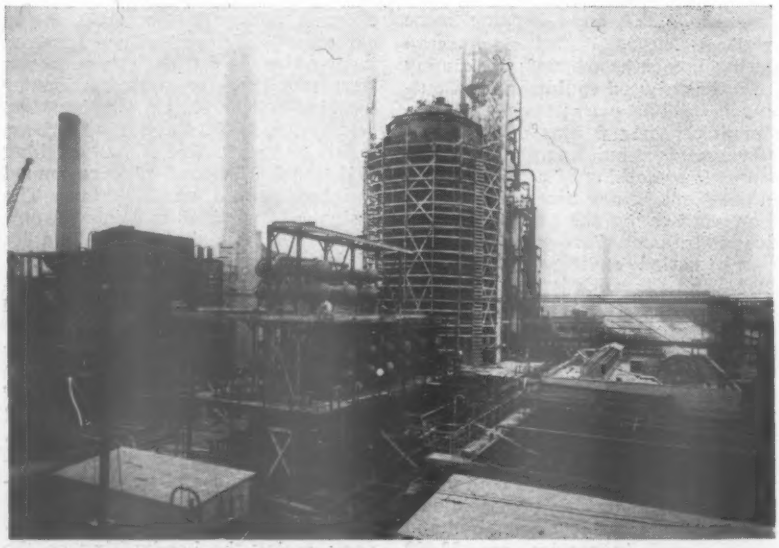
In one refinery 142 tons of scrap steel and 2½ tons of nonferrous metal were collected. Forty per cent of the exchanger capacity for a new plant was supplied from used and excess capacity at other plants. A total of seven boilers were transferred to other locations where they were needed seriously. One complete pump station was moved to another locality where the emergency has increased the pump load above normal. Several engine-generator sets have been moved to other locations, from places where they were not absolutely required. Three hundred seventy-five thousand barrels of crude storage capacity, in five tanks, was moved in toto several hundred miles and installed at a refinery where capacity requirements for gasoline storage have increased rapidly; the occasion permitting modernization of these tanks to the floating-roof type.

Especially useful was the steel obtained from four angle-iron derricks which were salvaged. From this material 10 separator towers were built which avoided purchase of 20,000 lb. of new steel. Salvage of turnbuckle derricks recovered 156 tons of reinforcing steel and 32,000 ft. of 3-in. pipe, all usable in new construction.

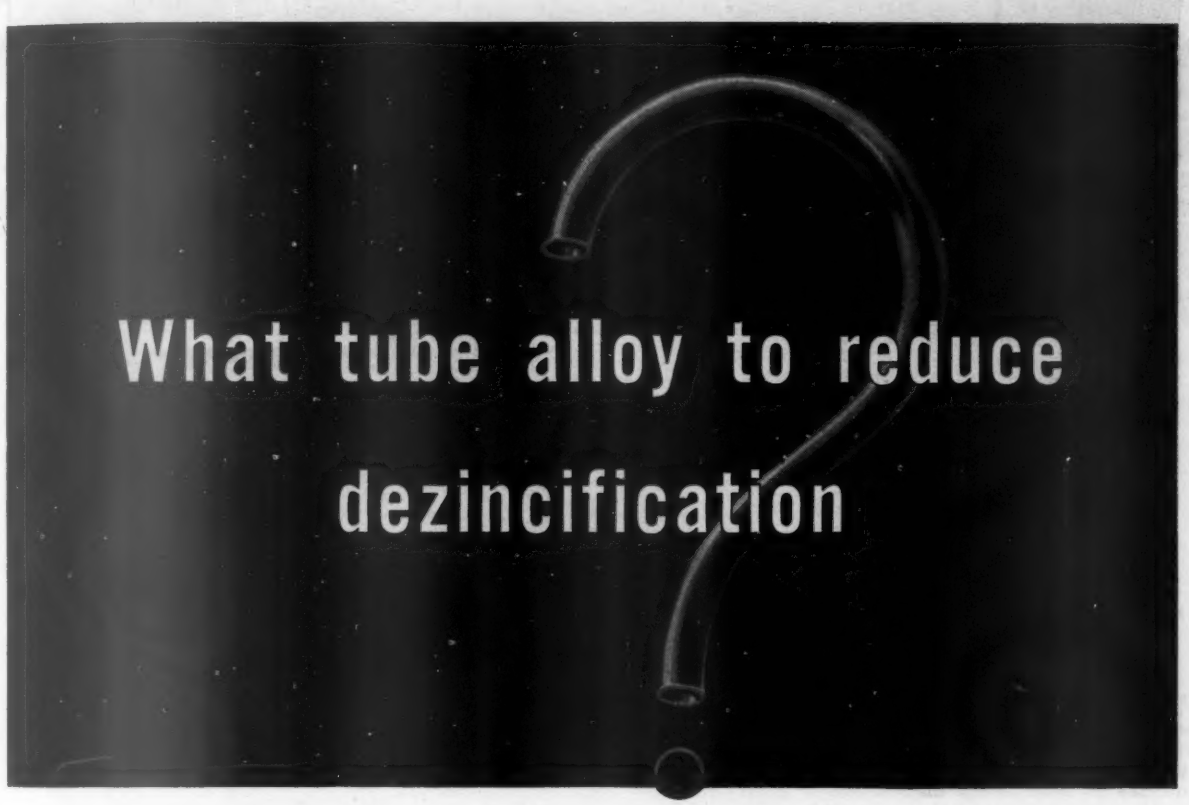
Use of Second-Hand Material

A complete gasoline plant, including field lines, was built from used equipment, 80 per cent of the material going into it having been salvaged from other applications. In extending the work of the cathodic unit to combat corrosion, several second-hand windwill towers were bought and installed at considerable new-material saving. A complete distillation unit was salvaged and sold for reuse. Tank heads retired from severe service were transferred to more mild use to avoid need for new heads.

Specific instances of this fine-tooth-comb method of salvaging and saving number in the hundreds; rebuilding valve bodies, plungers, bonnets; building up pump rods, pistons, valve seats; welding to build up worn or broken parts of every description; reclaiming gaskets, studs, flanges, collars, nipples, retipping still tubes and exchanger tubes. This brief outline of the detailed system which was instituted gives some idea of the method by which our irreplaceable supplies of metal and equipment may be conserved and made to serve our purpose until such time as new equipment may be purchased again.



A huge 33-ft. diameter fractionator of welded construction being installed in one of the wax-products refinery units. (Courtesy, Foster Wheeler Corp.)



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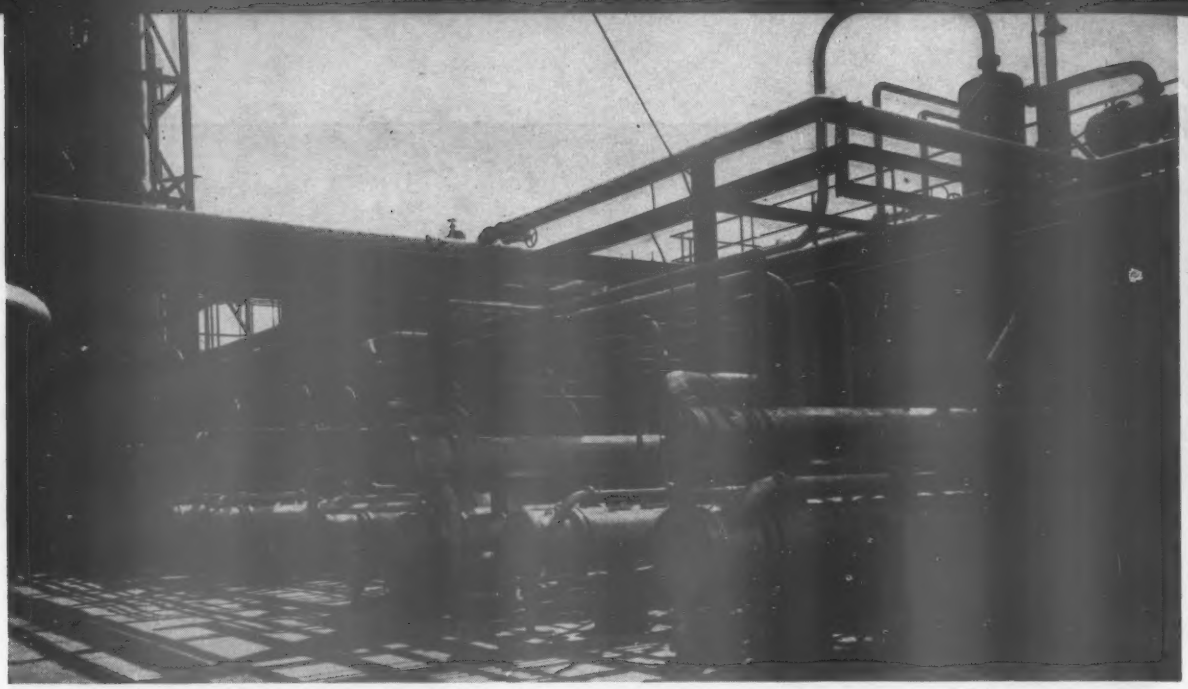

Heat exchanger and condenser efficiency has been upped to a remarkable degree in present-day practice. Here is a good example

Heat Transfer Coefficients For CONDENSERS

*by George T. Atkins, Jr.**

Determination and calculation of heat transfer rates and coefficients therefor are important steps in operating and designing condenser equipment. A new method is given here in detail, including equations and explanations for performing the nine steps.

THERE is little or no published information on the subject of heat-transfer coefficients for condensing vapors suitable for rating commercial shell-and-tube condensers handling vapor mixtures condensing through a fairly wide temperature range. This is because of the number and complexity of the phenomena, making it difficult to cover the subject by any simple theory or formula. It is possible, however, to obtain a good working solution by correlating the factors which appear to be of greater importance; and it is here the purpose to describe some attempts along this line which have so far met with success.

The general method of attack has been to establish a reasonably satisfactory theory to cover condensation in the presence of less easily condensable components, to test shell-and-tube apparatus condensing mixtures of various hydrocarbons with and without steam present, to calculate the various film resistances, adding them up to obtain a total resistance to heat flow and the corresponding over-all heat-transfer coefficient, and to adjust the various factors so that calculated and measured coefficients are in agreement. This procedure has been repeated many times with a variety of condensers and condensable mixtures so that the correspondence between calculated and experimental results has been obtained through a wide range of conditions. The data and calculations have been preserved for reference; so that when other calculations are to be performed, either for still further test results or for rating a new condenser, it is possible to turn to a comparable set of calculations which can then be used as a model. This is considered to be a necessary step when the object in mind is to combine both clear-cut numerical results with allowance for the new design features which are continually being encountered in practice; for then those features which are common can be kept so in the calculations, but for those which are different, suitable precedent or analogy can be sought.

When the problem is viewed in this manner, it is seen that a great many factors must be taken into account, and all of them correlated more or less simultaneously, thus including

*Humble Oil & Refining Co.

such subjects as physical properties, temperature differences, cross-section open to flow, leakage at baffles, pressure drop, etc. When a variety of examples of commercial condensation is examined, it is found that each of these factors in turn, sooner or later, seems to become controlling, hence, needs to be known with some claim to accuracy. Yet, in the majority of cases, attention can be directed principally to the question of the condensation itself.

Theory

Consider a vapor mixture consisting of one or more components easily condensable and one or more components less easily condensable, being partially condensed in a commercial-type bare-tube condenser, on the outside of the tubes, with a coolant fluid in the tubes. As condensation takes place the vapor will change in composition, due to a preferential condensation of the more easily condensable component. The less easily condensable components accumulate in the vapor phase, and there, by their partial pressure effect, reduce the condensing temperature. This accumulation of light ends occurs not only toward the outlet but also throughout the condenser, and especially so in the thin vapor film surrounding both the tubes and the condensate which wets the tubes. There is a concentration gradient through this vapor film, and a temperature gradient across it, dependent upon the thickness of the film and the amount of less easily condensable component present.[4] If this temperature gradient were directly measurable, or could be calculated with ease and accuracy, the problem would be greatly simplified; for then the average temperature gradient through the vapor film could be subtracted from the over-all temperature difference, leaving a known temperature difference from condensate to coolant. This, together with resistances (condensate, metal and dirt, and coolant) which can be evaluated with relative ease,[3] permits a direct calculation of the flow of heat per unit of tube surface.[3]

While the temperature gradient itself cannot be directly measured, the film resistance equivalent to it can be calculated by using an apparent specific heat, defined at the B.t.u. transferred, per pound of vapor going to the condenser, per °F. of temperature range from condenser inlet to outlet. This apparent specific heat is used in the dimensionless group (h/cG), in which h is the vapor film coefficient and G is the mass velocity. The vapor film resistance, h^{-1}, is then added to the other resistances (condensate, metal and dirt, coolant) and the over-all heat-transfer coefficient then found by taking the reciprocal of this total resistance. The dimensionless group (h/cG) is related to the dimensionless heat-transfer factor[1] j and to the dimensionless Prandtl number (2.42cz/k) by the well-known equation

$$(h/cG) = j\,(2.42cz/k)^{-2/3} \quad (1)$$

When this equation is solved for the vapor film resistance, and after substituting the quantities defining the apparent specific heat, the working equation obtained is:

$$h^{-1} = \frac{S \times T.R.}{144 \times Q \times j} \times (2.42cz/k)^{2/3} \quad (2)$$

In this equation h^{-1} is the vapor film resistance, the reciprocal of the film heat-transfer coefficient in B.t.u. per hour per square foot per °F.; S is the cross-section open to flow, measured in square inches; T.R. is the temperature range, °F., between inlet and outlet; Q is the B.t.u. per hour transferred; j is the heat-transfer factor; c is the true specific heat at constant pressure; z is the viscosity, centipoises; k is the thermal conductivity, B.t.u. per hour, square feet, °F. per foot; and the number 2.42 is a conversion factor required to make the three latter variables dimensionally consistent.

If in one extreme the vapor is a pure substance, the temperature range in the condenser proper is zero, and the calculated vapor film resistance is accordingly zero; this is a result which is in agreement with theory and observation generally, that is, that the resistance to heat transfer when condensing pure vapor is in the condensate film and not in the vapor.

If in the other extreme the vapor is pure noncondensable, Equation 2 reduces to Equation 1, with c being the specific heat of the vapor; this is then one of the standard forms for the correlation of heat-transfer data on liquids and gases, noncondensing.

In intermediate cases it turns out that, by calculation, the temperature gradient across the vapor film is in direct proportion to the temperature range of condensation, the latter being also in fair measure proportional to the amount of less easily condensable component present.

Thus, it is seen that the equation for use in determining vapor-film resistance brings together all the principal factors that would seem to influence heat transfer from condensing vapor mixtures, and relates them in a way consistent with theory. In the limiting cases of either all noncondensable or pure condensing component the equation is in agreement with well-established practice.

Familiarity with the details of theoretical condensation leads to the thought that the heat of condensation is liberated at the surface of the liquid film, hence the process at the vapor film is one of diffusion rather than true heat transfer. An academic end would be served if this concept were embodied in the calculations. In this event, the temperature gradient across the vapor film would be subtracted from the over-all temperature difference, so that the temperature difference used would be that across

A modern version of the older, open box, submerged-coil condenser used throughout the refining industry

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condensate film, tube wall, and coolant film. In this event also, the resistance (reciprocal coefficient) at the vapor film would be subtracted from the total resistance, so that the over-all resistance used would be the sum of the separate resistances for condensate, tube wall, and coolant film. Moreover, both over-all temperature difference and total resistance to heat flow would be diminished in the same proportion; this at least being implied in the assumption of constant heat flow and area inside the film of condensate. More especially, without benefit of direct measurement, the amount of temperature difference to subtract for the vapor film must perforce be obtained by calculation, perhaps in proportion to a hypothetical vapor-film resistance, perhaps even to that obtained in accordance with the present recommended procedure. Thus, it would be possible to return to the same numerical ratios as before, and to obtain the same answer, but with the benefit of perhaps a different and much better theory.

In the presence of a plurality of theories and good ones too, it is desired to advance none whatever, and certainly not to discredit any which may already have obtained recognition; but merely to point out that the entire question of the details of condensation mechanism may be avoided as not being of much apparent help in the present connection.

It remains to describe more fully the manner in which the principles and methods here held up to light can be made to serve the purpose of commercial testing and design.

Cross-Section of Flow

The cross-section of flow depends on the shell diameter and the degree of baffling in the condenser. It is usually difficult to calculate; because, in commercial apparatus, the type of flow is neither pure cross flow nor pure parallel flow, but highly complex.[5] It is therefore suitable to regard any method for the calculation of the effective cross-section and hence also the calculation of mass velocity as a thing established by experience and standardization. This will be especially true if, as is anticipated, the cross-section of flow is used also for pressure-drop calculations and if the latter are to be performed in accordance with an established procedure. Nevertheless, a method for the calculation of cross-section of flow will now be described, not with the object of displacing some other good and established method, but merely to serve those who might not have at hand some other procedure on which they have come to rely. The steps of this method are:

1. Determine whether the fluid will be confined within the bundle proper by deflector plates (side strips) in the annular space between the bundle and the shell, or whether the absence of these plates will permit the fluid to flow through the annular space. In the former event, bundle O.D. proper may be used; in the latter event, arbitrarily define the bundle O.D. (unit, inch; symbol, B.O.D.) as equal to the nominal shell I.D.

2. Calculate the area of a circle having the same diameter as the bundle O.D., divide by the number of shell side passes (passes of equal cross-section), call the result the gross cross-section (unit, square inch; symbol, G.C.S.).

3. Multiply the number of tubes per shell side pass by the cross-sectional area per tube (basis tube O.D.), subtract the resulting area (square inches) from the gross cross-section, call the result the net cross-section (unit, square inch; symbol, N.C.S.).

4. Count the number of tubes passing through the cut-out portion of the baffle, express as a fraction of the total number of tubes, multiply this fraction by the net cross-section, call this product the free cross-section (unit, square inch; symbol, F.C.S.). In arriving at a numerical value, allowance should be made for leakage between baffle and tubes, and baffle and shell.

5. Calculate or measure an average linear dimension across the baffle from the center of area of the inlet to the center of area of the outlet; for single-pass shells with segmental baffles, calculate this dimension by subtracting from the bundle O.D. the product of bundle O.D. times the ratio (F.C.S./N.C.S.). Call the result the linear dimension of the baffle (unit, inch; symbol, 1).

6. Increase the linear dimension in proportion to the obstruction to flow resulting from the tube layout, by multiplying by a factor 1.5 for tubes in line, say ¾ in. O.D. on 1 in. sq. centers, or a factor 2.0 for staggered tubes, say ¾ in. O.D. on 15/16 in. triangular centers, or other factors in about the same range depending upon the tube layout and direction of flow. Call the result the lateral dimension (unit, inch; symbol, L).

7. Note the distance between baffles, which for convenience may be taken as the center-to-center dimension. Call the result the tube length between baffles (unit, inch: symbol, N).

8. Calculate a diagonal dimension between baffles; that is, find the square root of the sum of the squares N and L, and call this diagonal the length of fluid path between baffles (unit, inch; symbol, M).

9. Multiply the net cross-section by the distance between baffles, which gives a volume, then divide by the length of fluid path, which gives a cross-section open to the flow of fluid (unit, square inch; symbol, S).

Header-type condenser section showing a high condensation efficiency. (Frick-Reid)

Representative Cross-Section

In the handling of problems of condensation, it is frequently found

that the equivalent of integration is required, it being necessary either to divide the condenser into several sections (for the purpose of calculation) or to establish point conditions within the condenser and to estimate the surface area per unit of performance, first for the point conditions, thereafter by graphical analysis, for the condenser as a whole.

Problem of New Design

Fortunately, it is perhaps as frequently found that acceptable results can be obtained by a single calculation involving average or representative conditions, and extending or extrapolating the results to the condenser as a whole. This latter is especially desirable when a saving in time is effected thereby. An examination of Equation 2 above will indicate how the problem should be approached in the case of new design. Throughout the condenser there will be little change in the values of Pr and j. But, near the outlet, the conditions may approximate liquid subcooling in the presence of a high partial pressure of less easily condensable component, with the sensible heat effect becoming a larger proportion of the total heat duty. In this case the temperature range per unit of heat duty increases; so that if vapor-film resistance is to remain constant, S must decrease as T.R./Q. increases. This is accomplished by spacing the baffles on closer centers near the outlet than at the inlet. This being done, vapor-film resistance is relatively constant, and average conditions, hence average cross-section, may be used.

It will sometimes be wise not to attempt any great degree of liquid subcooling in the condenser; hence the baffle spacing may tend toward uniformity, especially so in the case of partial condensers. The average baffle spacing could then be used in the calculation of S.

On the other hand, if liquid subcooling is to be attempted in the presence of noncondensable component, it is to be expected that many of the tubes will not be covered with liquid, and will be relatively ineffective in the removal of heat. In this case the baffle spacing near the central region of condensation might be used for the calculation of average cross-section. But in case a supposedly effective subcooling section were present, this should be figured separately according to whatever method of calculation is applicable.

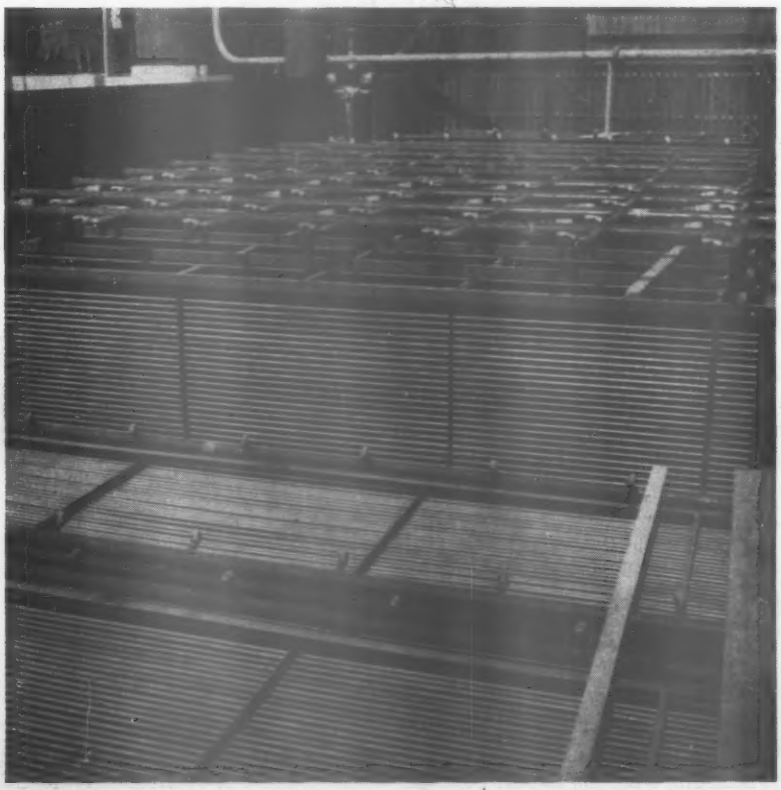
TABLE 1—True Countercurrent Condensation

	Hot end (°F.)	Intermediate (°F.)	Cold end (°F.)	Over-all (°F.)
Vapor	210	200	105	...
Coolant	170	130	100	...
Difference	40	70	5	...
L.M.T.D.	53.7	24.7	37.4	

TABLE 2—Two-Pass Coolant, Single-Pass Vapor

	Hot end (°F.)	Intermediate (°F.)	Cold end (°F.)	Over-all (°F.)
Coolant, first pass	100	130	140	...
Coolant, second pass	170	150	140	...
Coolant, average	135	140	140	...
Vapor	210	200	145	...
Difference	75	60	5	...
L.M.T.D.	64.7	22.2	41.0	

View of a condenser showing how sections and manifolds are assembled



Temperature Difference

Usually, the log-mean-temperature-difference formula, using the terminal temperatures of the fluid media for the calculation of an effective over-all temperature difference, does not give very satisfactory results when applied to vapor condensers. This is because usually both sensible heat and latent heat are given up by the condensing media in different proportions in the various parts of the apparatus, thus distorting the linearity of the relation between heat transferred and temperature difference, and voiding the application of the log-mean-temperature-difference formula.

However, if the intermediate temperatures in the apparatus are known with sufficient accuracy, the condenser can be considered as if in several sections. This is a good method, and generally applicable, but is usually more lengthy than is warranted by the degree of accuracy attainable. A short-cut method, as follows, appears to be justified.

In addition to the two terminal-temperature differences, an intermediate-temperature difference is obtained by estimating the fluid temperatures at a representative point, say about half way through the apparatus. Then the log mean of the inlet and intermediate, and of the intermediate and outlet - temperature differences are taken, to obtain two temperature differences; and then the log mean of the two log mean temperature differences themselves is taken, so as to obtain an effective over-all temperature difference between the condensing vapors and the coolant. The procedure will be readily apparent from the numerical illustration shown in Table 1.

If the flow is not truly countercurrent, then effective coolant temperatures at the vapor inlet, intermediate point, and outlet are found by averaging the temperatures of the coolant in the several passes at the location in question. Some estimating will be required, but otherwise the procedure is straightforward, as may be seen in Table 2.

In the event of the vapor entering in a superheated condition, it is suggested that, whenever the tube-wall temperature is lower than the dew point of the vapors, the dew point itself be substituted for the vapor-inlet temperature in the calculation of temperature difference.

The logarithmic mean temperature difference (L.M.T.D.), found by using only the uncorrected terminal temperatures, has utility as a reference number because from a given set of data it is exactly reproducible. There would therefore be a tendency to retain it. This can be done to advantage by setting forth also a correction factor (C.F.) defined as the ratio of the corrected mean temperature difference (C.M.T.D.) to the L.M.T.D. For example, in the two numerical illustrations (Tables 1 and 2), the respective correction factors are (1), C.F. = 37.4 / 16.9 = 2.21, and (2) C.F. = 41 / 42.5 = 0.96. The first correction factor is greater than unity because of an abnormally high intermediate temperature difference; the second correction factor is less than unity because of the unfavorable temperature distribution of the coolant with relation to the condensing vapor.

Regardless of rules and definitions, the correction factor for temperature difference will be to some extent objectionable because of the lack in each individual case of demonstrable justification and reproducibility for the numbers used. It will be apparent, then, that it would be better in many cases to avoid the issue by expressing the final results of a calculation in terms of the uncorrected log mean temperature difference, reporting this together with an apparent over-all heat-transfer coefficient. The latter, if divided by a suitable temperature - correction factor, should yield the true over-all heat-transfer coefficient, that is, the reciprocal of the sum of all the film resistances.

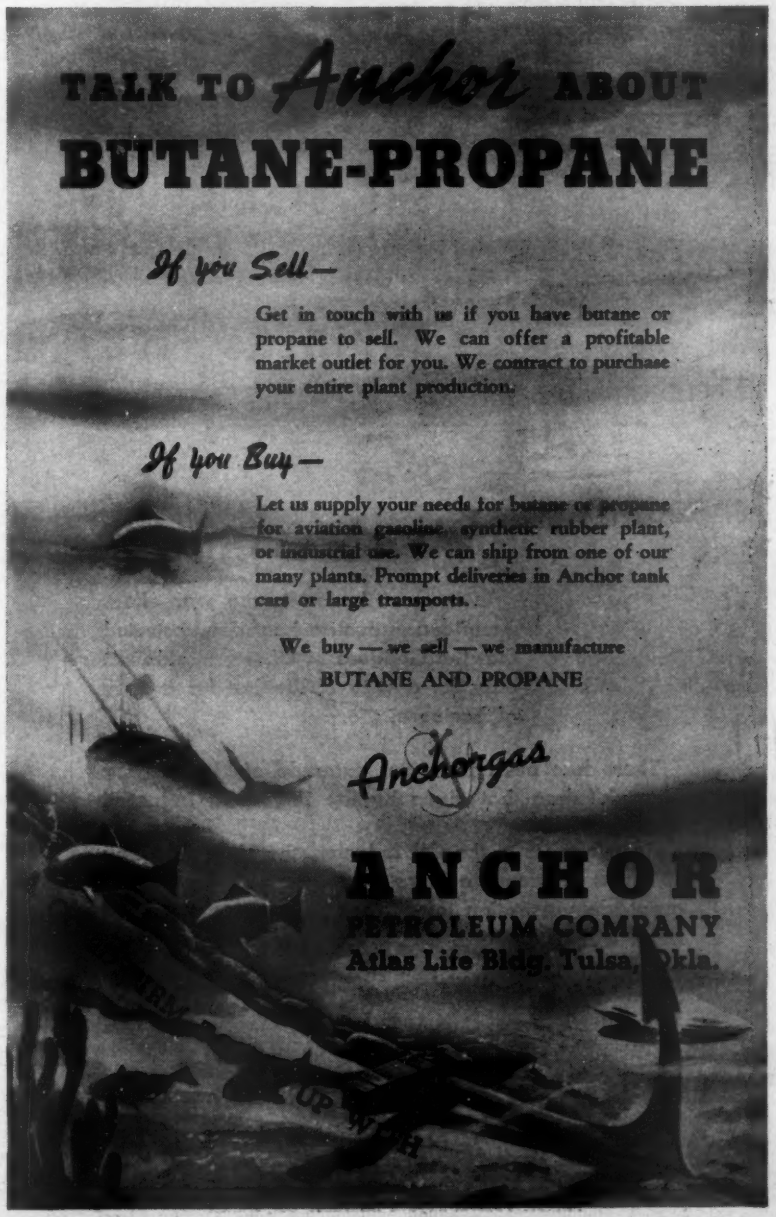
Temperature Range

The temperature range of condensation is the difference in temperature between vapor at the inlet of the tube bundle, and vapor at the outlet of the tube bundle. It is possible for the noncondensed vapor to leave either cooler or warmer than the condensate, but usually the temperature of either, for practical purposes, is the same as the measured temperature in the outlet line.

There are important exceptions, however, which should be kept in mind. As one example, vapor may be brought in at the bottom of the condenser, noncondensed vapor removed at the top, and condensate brought by gravity downward to the outlet and there removed, counter to the flow of incoming vapor. The condenser may perform as if composed of two sections, the lower, in which the bulk of the condensation occurs, acting as an efficient condenser; and the upper section, in which there may be relatively little condensation, acting as an efficient gas cooler. If an over-all measure of performance were desired, it would appear logical to use the corrected mean temperature difference (inlet, midpoint, and vapor outlet) for the calculation of the heat-transfer coefficient or required area; and also the temperature range from vapor inlet to vapor outlet (T.R.) for use in Equation 2. If the range of conditions were extreme, it would be good practice to calculate the condenser by steps, as if it were in several sections.

Sometimes also, vapor is admitted to one side of the condenser, condensate is removed from the bottom, and noncondensed vapor from the top. As before, if calculated as one section, the temperature range may be taken from vapor inlet to vapor outlet. However, three sections (main condenser, gas cooler, condensate subcooler) might be distinguished.

Similar to the above is the case of a simple downflow condenser in which liquid subcooling is attempted,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but in which some gas cooling also occurs. In such a case, performance might be better represented, not by using the temperature of the condensate in the outlet from the condenser, or even the common temperature attained by condensate and noncondensed vapor in the running line from the condenser, but rather by estimating some more representative temperature for the vapor surrounding the tubes in the vicinity of the outlet.

It is seen that when unlike types of heat transfer are lumped together, the selection of terminal temperatures may become difficult; and that then it is better to divide the condenser into sections. In most cases it is anticipated that this problem will not arise, and that no differentiation between the outlet temperatures of gas and condensate will be required. In any event, it is suggested that the temperature range be considered at least as the temperature of saturated vapor, such as surrounds the tubes at the inlet, minus the temperature of vapor surrounding the tubes near the outlet. This is intended to apply to desuperheating as well as condensing, the dew point being used as the temperature at the inlet whenever the tube-wall temperature is below the dew point of the entering vapor.

Reynolds Number

The practice of evaluating the Reynolds' number in problems of heat transfer is so general that only particular aspects of the subject need be considered here. It will be recalled that the Reynolds' number, Re, is evaluated in order to read off a corresponding value of the heat-transfer factor, j, from an appropriate chart[2]; and that the variables are expressed in various units of measurement and the nomenclature varied somewhat, also, in the several systems in current use. These ways are all good when properly understood and used, hence should be applicable in the present instance for the calculation of vapor-film resistance. It would be well to adhere to any method which has become standard, rather than to seek a new one.

But if there is no standard method at hand, or if it be urged that these methods are all reserved for other use, and that the introduction of new definitions and procedures above has invalidated them for use here, then some brief outline of an alternate procedure may be of value. This is as follows:

1. Whether for cross flow, radial flow, diagonal flow or parallel flow, to obtain the equivalent diameter for the Reynolds' number, subtract the tube outside diameter D from the center-to-center distance, thus getting the clearance between tubes, a; multiply by 3, and call the product 3a, the equivalent diameter (unit, inch; symbol, d).

2. Multiply the ratio of W, the shell-side throughput in pounds per hour, to S, the cross-section open to flow, square inches, by a conversion factor 0.04 (which is itself the ratio of 144 to 3,600). The result, 0.04 W/S, is the mass velocity (unit, pounds per second per square foot; symbol, G).

3. Obtain the viscosity, centipoises, of the vapor mixture from one of the standard sources. If other information is lacking, then an empirical equation becomes useful. It has been found that the average molecular weight, M, and the Fahrenheit temperature, T, can be used, together with constants, to obtain reasonably satisfactory values for the viscosity of hydrocarbon vapors; thus

$$z = 0.0022 \frac{(T + 500)}{(M + 100)}$$

The viscosity is taken at the average film temperature.

4. Calculate the dimensionless Reynolds number, Re, using an over-all conversion factor of 124 to make all units consistent, by the formula,

$$Re = 124\ dG / z \qquad (3)$$

Heat-Transfer Factor

The dimensionless heat-transfer factor, j, has already been defined by use of Equation 1 above. Knowledge of this group is had by experiment, in which values of h, c, G, z, and k are obtained as data, permitting the calculation of j, and its correlation,

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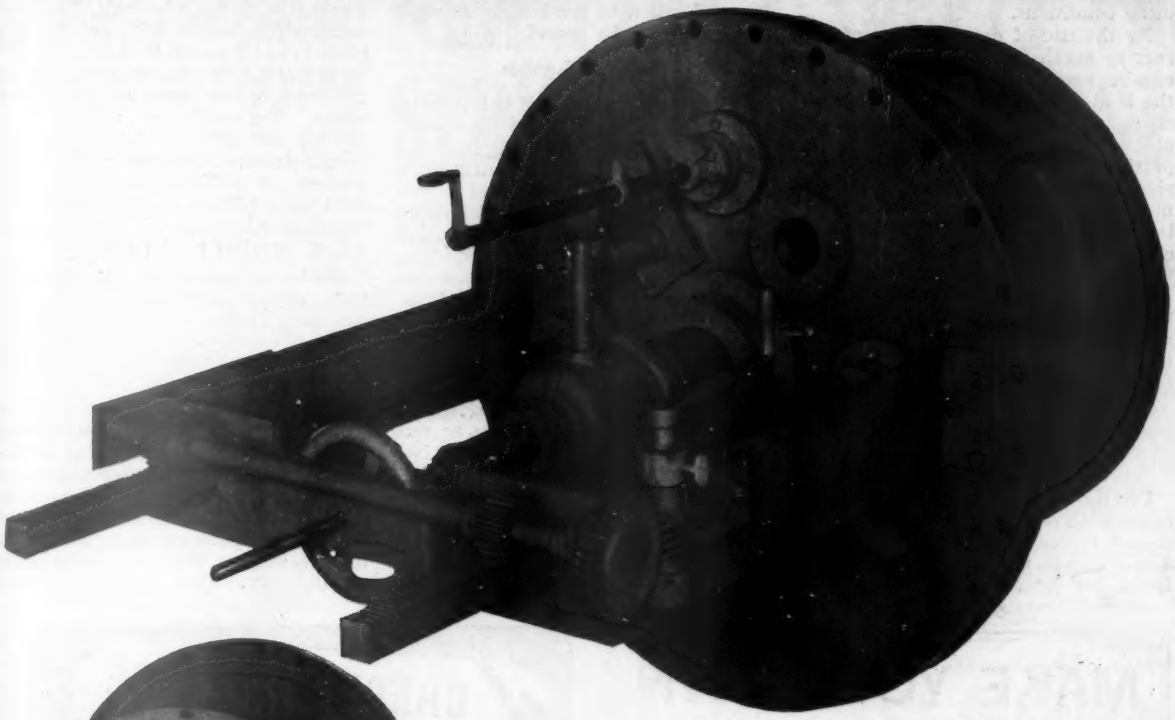

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customarily as a function of the Reynolds number and the arrangement of the tubes and baffles. Then in turn, knowing the arrangement of tubes and baffles in a new bundle, it is possible to estimate how well the correlations which appear in the literature may serve, and over what range of Reynolds number, for the purpose of predicting the heat-transfer factor for the new bundle at the new operating conditions.

By the use of design charts of one sort or another it is thus possible to obtain very satisfactory values for the heat-transfer factor. But if these charts are lacking, or not very suitable in the designer's opinion for the particular conditions then being considered, or if by chance the Reynolds' number as found is not believed to be suitable for use with the designer's charts, then an alternative procedure would perhaps be welcomed.

The availability of data on baffled heat exchangers[7] has made it possible to derive a heat-transfer equation for various fluids with various types of baffling.

$$3{,}600j = 5 + \frac{200d}{M} + \frac{1{,}600}{Re^{1/3}} \qquad (4)$$

For convenience a factor of 3,600 is applied above. This not only makes it easy to keep track of decimals, but also supplies a necessary conversion factor between G (second) and h (hour), when solving Equation 1 for the latter. The calculation of d, M, and Re has been described above. It will be seen that the heat-transfer factor is dependent both upon baffle spacing (relative to equivalent diameter) and upon turbulence. This equation has turned out to be satisfactory for many kinds of baffling, or none at all, and for fluids and vapor mixtures under a range of conditions. Its application to condensers as well, is believed to be sound.

Prandtl Number

It has been stated that the Prandtl number (2.42cz/k) should be dimensionless, the factor 2.42 being included in order to convert z, in centipoises, to units consistent with c and k (per foot). The Prandtl number for gases seems to show little variation, being near unity for many vapors. This group is usually important, not for its proper effect, but because of the opportunity for error associated with the selection of compatible values for c, z and k in the usual case where data is lacking.

Because the group itself can probably be evaluated as closely as can the variables entering into it, it has seemed advisable to use this approach, and to calculate its value from other variables (molecular weight and specific heat) which can be established with reasonable accuracy. Thus reproducibility, if not accuracy itself, is attained. The empirical equation for the dimensionless Prandtl number for gases is, then:

$$(cz/k) = (Ms\text{-}2)/Mc$$

Condensate Film

As vapor condenses, the liquid condensate wets the tubes (usually) and forms a film which by interposition reduces the flow of heat from the vapor film to the tube wall. The condensate film moves with an effective mass velocity which is induced partly by the action of gravity and partly by the drag of the surrounding moving vapor.[8] For condensers with inlet at the top and outlet at the bottom, test results indicate that these two components of velocity can be considered as additive, even though the principal direction of flow is horizontal, parallel to the tubes.

That component of the effective mass velocity attributable to gravity has been found to be approximately 10 lb. per second per sq. ft.; at least, such seems to be the limit approached in drip-type condensers.

That component of the effective mass velocity induced by the moving vapor depends upon the degree of baffling and the resulting vapor velocity and vapor friction. To obtain a relation it becomes necessary to resort to a theory; therefore, it is assumed that mass velocities which cause the same pressure drop are equivalent. The

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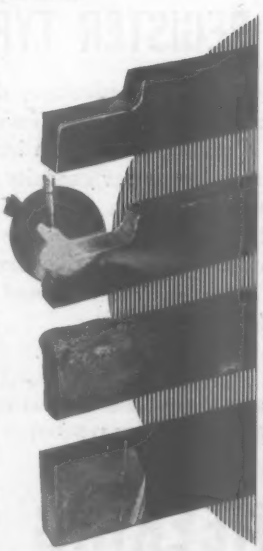

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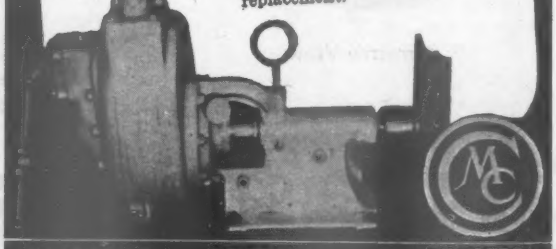

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NEW TYPE F SAFETY VALVE SERVES DUAL PURPOSE...

A positive, automatic Sub-Surface Tubing Safety Valve and Bottom Hole Choke... that's the New OTIS Type F Safety Valve. Serving a dual purpose, it is positive, yet no more complicated than any ordinary piston assembly.

It is essentially a spring loaded piston, through which an orifice is drilled to serve as a flow bean. On the lower end of the piston and extending below the body of the tool is the valve. Flow enters the flow bean through four horizontal ports in the piston, situated just above the valve. (Fig. 1) The entire flow is directed through the bean by pressure-seal packing within the housing.

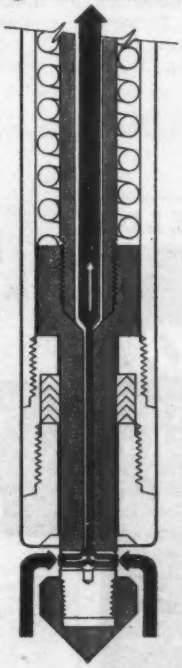


Fig. 1

The piston is held open by compression in the spring which forces the piston down against the upward force of the flowing differential pressure. The instant this pressure differential exceeds the amount for which the spring was adjusted, the piston moves up, the valve engaging the seat and shutting off all flow through the tubing.

The tool is operated entirely by pressure differential and is not dependent upon flow velocities.

Fig. 2

This feature completely eliminates the sensitiveness and inconsistencies that frequently cause trouble with velocity type valves.

The Type F Safety Valve has been used primarily in gas wells, condensate wells and wells with high gas/oil ratios to prevent freezing in flow lines, and at the same time to provide protection against uncontrolled tubing flow. The practice is to introduce sufficient compression into the coiled spring to hold the piston in its open position so long as the well is producing against the pressure maintained on the surface gathering system, but to close instantly should the surface pressure drop below a predetermined level. This provides an automatic Sub-Surface shutoff in the event surface connections fail or are damaged from any cause.

NEW CONSTRUCTION PREVENTS FLOW-CUTTING

Resistance to abrasion, most important feature

The abrasive action of the flow stream was one of the most important considerations in the basic design of the Type F Valve. The cutting action of the flow stream entering the valve is greatly reduced by placing the four horizontal ports at 90 deg. angles. This causes the flow entering each port to deflect upwardly against the flow from the opposite port, thus cushioning the change of direction and greatly reducing cutting at this point. (Fig. 2.)

The construction of the new valve is such that both the valve and valve seat are placed out of the direct line of flow beneath the bean where the flow velocities are relatively slow. The flow course above the bean is one straight bore through the valve and mandrel assembly—streamlined with no baffles or projections to be cut out or to impede flow. (Fig. 1.)

The Type F Safety Valve is set at a depth where the temperature of the flow stream is sufficiently high to absorb the temperature loss due to the pressure drop without causing freezing in the flow stream.

Like all other Otis Sub-Surface Controls, the Type F Safety Valve is run and pulled under pressure on a steel measuring line.

EW DESIGN CREATED FTER MONTHS OF EXPERI-ENTAL FIELD TESTING

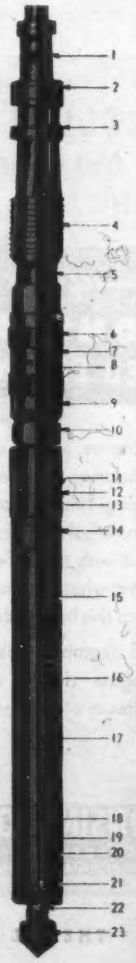
e New Type F Combination Bottom Hole Choke d Automatic Safety Valve was not created over-ght—nor was it the result of a sudden inspira-n. On the contrary, many months of actual field sting with tools of various designs and construc-ns were required before the design was devel-ed that would give the desired performance. owever, each test of these various experimental signs revealed helpful data and information that entually lead to the construction of the new tool. Vithout these extensive preliminary tests, the new nstruction probably would never have been und. Now, after having closely observed for eight onths the results of several of these new Type F alves installed in high pressure wells with severe rasive flow action, Otis is very much pleased with eir performance and has given them its stamp of pproval.

YPE F DESIGNED TO EET SPECIFIC NEEDS

revents Freezing of Flow Lines nd at Same Time Safeguards Vell Against Uncontrolled Flow

he purpose of this new tool is to rovide a Removable Bottom Hole hoke to which is added a Safety alve which completely closes off ow through the tubing whenever e pressure differential across the ecial Bottom Hole Choke Bean xceeds a predetermined amount. he pressure differential at which e valve operates can be adjusted ver such a wide range that this ew tool can be used very effec-vely as a Tubing Safety Valve nly, or as a combination Bottom ole Choke and Tubing Safety alve.

As in the case of the Regular Bot-m Hole Choke, this new combi-ation tool reduces the flowing ressure at a depth where the tem-erature of the gas is sufficiently igh to permit the temperature loss ue to gas expansion without caus-g freezing in the flow stream.



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4. Slips
5. Mandrel
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7. Upper Sealing Cup Ring
8. Cup Ring Packing
9. Lower Sealing Cup Ring
10. Cup Nut
11. Equalizing Orifice Plate
12. Equalizing Valve
13. Equalizing Valve Spring
14. Valve Cage
15. Adjusting Ring
16. Safety Valve Spring
17. Bean Extension
18. Bean
19. Packing Housing
20. Chevron Packing
21. Valve Seat
22. Intake Ports
23. Valve

OTIS PRESSURE CONTROL, INC.
DALLAS, TEXAS

condensate, being denser than the vapor body, would require a higher mass velocity (but lower linear velocity) to produce an equivalent pressure-drop effect; and the factor relating the respective velocities, other things being equal, is the square root of the ratio of densities. Thus a local vapor current, impinging against the condensate film, would induce a motion contributing to heat transfer through the condensate film, the induced mass velocity being dependent upon the vapor mass velocity, and vapor density, and the liquid density.

It is to be expected, however, that the interaction between vapor and liquid will not be complete, but that there will be local accumulations of condensate shielding part of each tube or parts of the bundle from the impact of the main body of vapor. A correction factor to cover such an effect would seem to be indicated.

But moreover, a slight spread in the apparent degree of contact seems to be indicated by the data already collected, and perhaps a wider variation might be found in still other instances. It therefore appears desirable to recognize that the effect of velocity is influenced by the efficiency of contact between vapor and condensate, to be represented by the symbol E in Equation 5 below. The value of E appears to vary from 0.3 to 0.5, but the accuracy of the calculations is not enough to be sure of the value in all cases. Approximately, a value of 0.3 was found when the horizontal travel of the condensate was greater than about 200 in.; 0.4 when the horizontal travel was from 50 to 200 in.; and 0.5 when the bundle was vertical. This trend may perhaps be accounted for if the respective velocities induced by gravity and vapor drag should really have been added vectorially rather than arithmetically.

The nature of the calculations will now be understood by inspection of the equation for the effective mass velocity of the condensate.

$$G_c = 10 + EG_v\,(c_c/s_v)^{1/2} \qquad (5)$$

Having once found the effective mass velocity of the condensate (lb. per second per sq. ft.), and having looked up the physical properties (c, z and k) of the condensate at its average film temperature, the film heat-transfer coefficient can easily be found. First, the Reynolds' number is calculated, as for the vapor, by the use of Equation 3; then the heat-transfer factor is calculated from Equation 4; then lastly Equation 1 is solved for the heat transfer coefficient:

$$h = 3{,}600j\ c\ G/(2.42cz/k)^{2/3}$$

The condensate film coefficient for hydrocarbons seems to be about 200 to 400 for crossbaffled condensers, and about 100 to 200 for longitudinally baffled condensers. In some cases higher or lower coefficients might be expected, depending upon the factors involved.[3]

Performance Data

Over a period of years an amount of test data has been accumulated so that it is possible to present a fairly well rounded-out picture of the quantitative effect of the factors controlling the performance of commercial condensers, as in Table 3. The 10 condensers listed are the products of six manufacturers. The vapors can be classified into about five groups, by boiling range, from propane to paraffin oil; the corresponding pressure range is from 290 down to 0.25 lb. per sq. in. absolute.

On each condenser certain general information is given; then follows the temperature differences in the apparatus, the over-all heat-transfer coefficient based on the corrected log mean temperature difference, and the summary of film resistances. The more important numbers entering into the calculation of the vapor film coefficient are then listed, and the same is done for the condensate film coefficient. These numbers have been rounded off so that the magnitude

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of the significant figures can be the more readily seen.

The relations between certain numbers, and various minor trends and effects, might be of considerable interest during the course of design of some new condenser as a means for arriving at an optimum selection. But the major effect, to be plainly seen, is the action of the crossbaffles in improving both vapor and condensate mass velocities and thus the film heat-transfer coefficients and the over-all performance of the unit.

Necessity for Economy

In view of the current necessity for economy in the use of tubular apparatus, it is desirable to maintain the highest possible heat density and heat-transfer coefficient. The table of data shows the extent to which this has been accomplished by the use of crossbaffles and the contrast in performance between high mass velocity and low mass velocity condensers.

The natural limit to the amount of baffling which can be profitably attempted will depend in part upon the film resistances of coolant, metal and dirt, and in part upon the allowable friction pressure drop. The latter will be related to the operating pressure, so that a relation is therefore to be expected between operating pressure and allowable vapor mass velocity. From the table of data it is found that the vapor mass velocity, pounds per second per square foot, can be from about 1.2 to 2.4 times the square root of the absolute pressure in pounds per square inch. In combination with this figure, a condensate mass velocity of about 60 lb. per second per sq. ft., but not much higher, would appear to be warranted. Some of the condensers are shown to be operating at substantially lower velocities, but these are judged to be using only an inconsequential proportion of the available pressure for frictional pressure drop and for the promotion of heat transfer.

Summary and Conclusions

There is some reason for believing that the system of calculation as developed here permits a separation between the respective effects of vapor and liquid film resistances in the transfer of heat from condensing vapor mixtures in commercial type condensers and vapor heat exchangers. Specific directions are given for the calculation of the more important variables controlling heat transfer, in particular the mass velocities of the vapor and of the condensate. Test data on 10 installations expressed in terms of the derived results, illustrate the range and magnitude of the variables.

It is concluded that crossbaffling within designated limits can aid in improved performance, and thus in economy of heat transfer surface and in conservation of the materials used in the construction of heat transfer apparatus.

Acknowledgment

Over a period of years many excellent tests of tubular apparatus have been made by the members of the technical service division of Humble Oil & Refining Co. It is desired to acknowledge the hearty cooperation of the members of this organization; and more specifically, the work done by W. M. Harp, G. F. Horton, D. R. Keck, W. B. Ogilvie, J. R. Barsalou, K. J. F. Dutson and Dr. W. B. Franklin in securing test data discussed previously. The results obtained are also due in large measure to the excellent work done by Thomas Whelan and D. R. L. Dockendorff in the calculation and analysis of test results. T. R. Heyck and K. B. Ris, of Griscom-Russell Co., have encouraged the presentation of these views on the relation between vapor velocity and heat transfer coefficient. Especial pride is taken in acknowledging the generosity of Humble Oil & Refining Co. in permitting the publication of this memorandum.

Literature Cited

1. Colburn, A. P., Trans, Amer. Inst. Chem. Eng., 29, 174-210 (1933).

2. Drew, Hottel, and McAdams, Trans. Amer. Inst. Chem. Eng., 32, 275 (1936).

3. Kirkbride, C. G., Ind. Eng. Chem. 25, 1,328 (1933).

4. Lewis, W. K., Trans, Amer. Inst. Chem. Eng. 20, 9 (1927).

5. McAdams, W. H., "Heat Transmission," McGraw-Hill, New York (1933), pp. 224-233.

6. Monrad and Badger, Ind. Eng. Chem., 22, 1,110 (1930).

7. Short, B. E., Univ. of Texas, Bull. 3,819, May 15, 1938.

8. Tubular Exchanger Manufacturers Association, "Standards," 386 Madison Ave., New York (1941), pp. 13-44.

TABLE 1—Condenser Performance

Identification—	A	B	C	D	E	F	G	H	I	J
Pressure, lb. per sq. in. abs.	290	290	120	80	20	17	17	15	15	0.25
First vapor component	Propane	Propane	n-Butane	Butane	Naphtha	Naphtha	Naphtha	Gas oil	Gas oil	Paraffin Oil
Second vapor component	Ethane	Ethane	i-Butane	Propane	...	Steam	Steam	Steam	Steam	
Coolant	Water	Water	Water	Water	Crude oil	Crude oil	Water	Gas oil	Crude oil	Crude oil
Horizontal or vertical	Hor.	Hor.	Hor.	Hor.	Hor.	Hor.	Hor.	Hor.	Vert.	Hor.
Cross or Long. baffles	Cross	Long.	Cross	Long.	Long.	Long.	Long.	Long.	Cross	...
Countercurrent flow	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes
Temperature differences:										
Hot end	10	7	13	25.5	76	50	85.5	68	277	200
Intermediate	21	21	30	30	88	65	78	130	113	100
Cold end	25	34	46	25.5	100	81	38	180	21	29
C.M.T.D.	18.7	19.0	28.2	27	88	65	68	123	107	94
Heat-transfer coefficient	157	60.4	217	74.5	31.1	45.5	100	31.2	45.7	8.0
Film resistances:										
Vapor	0.0002	0.0027	0.0001	0.0011	0.0043	0.0040	0.0033	0.0137	0.0118	0.0820
Condensate	0.0032	0.0085	0.0027	0.0073	0.0078	0.0078	0.0053	0.0083	0.0044	0.0135
Tube metal and dirt	0.0003	0.0016	0.0005	0.0035	0.0021	0.0004	0.0004	0.0019	0.0009	0.0120
Coolant	0.0026	0.0038	0.0013	0.0015	0.0180	0.0098	0.0010	0.0081	0.0048	0.0175
Total	0.0063	0.0166	0.0046	0.0134	0.0322	0.0220	0.0100	0.0320	0.0219	0.1250
Vapor film:										
Mass velocity, G	29.7	1.45	26.5	4.7	3.1	2.4	6.5	5.7	4.8	0.6
Reynolds number, Re	210,000	13,900	122,000	46,000	38,000	28,000	76,000	52,000	39,000	13,000
Transfer factor, 3,600j	13	23	17	17	16	19	16	14	29	20
Temperature range, T.R.	10	11	7	13	30	20	70	199	256	251
Prandtl number, (cz/k)	0.88	0.89	0.91	0.91	0.95	0.94	0.94	0.97	0.93	0.99
Vapor film coefficient, h	5,000	370	9,000	900	230	250	300	73	85	12.2
Condensate film:										
Contact efficiency, E	0.3	0.4	0.3	0.3	0.4	0.4	0.4	0.3	0.5	0.3
Density ratio (s_l/s_v)	11.2	10.5	35	42	131	203	176	193	470	5,200
Mass velocity, G	40	12	57	19	24	24	45	34	62	23
Reynolds number, Re	31,000	12,000	41,000	13,000	10,000	9,000	13,000	6,000	7,000	2,000
Transfer factor, 3,600j	19	24	20	23	23	27	14	28	19	40
Prandtl number, (cz/k)	1.56	1.56	2.26	2.4	3.9	4.2	5.3	9.5	15	20
Condensate film coefficient, h	310	120	370	140	130	130	190	120	230	74

WATER TREATING—

Corrosion prevention by vapor-phase treatment in steam-making units is one of the new developments

by Charles E. Erb *

GENERAL primary treatments of boiler waters, such as zeolite, lime, lime-zeolite, and lime-soda are seldom sufficient to complete the job and internal followup treatment is general practice. In large central electric-generating plants, and in some other cases, new boilers designed to operate at pressures up to 2,400 lb. are being put into use. These extreme pressures present special problems. Even traces of scale and corrosion may be dangerous. The walls of these boilers are water cooled, by tubes which serve to generate steam as part of the boiler. Integral furnaces are common in high-pressure units. The capacity of these boilers is usually rated in pounds of steam per hour instead of in horsepower. Steaming rates are high, and because of the comparatively small amount of water in the drums, they are very sensitive and conditions must be closely controlled.

In refineries, boiler pressures as high as 600 lb. per sq. in. are rare and most units operate below 300 lb. per sq. in. Both fire-tube and water-tube boilers are used, and the oil-field type of of fire-tube unit is popular. The following discussions will ignore the extreme pressure conditions. Pressures under 600 lb. per sq. in. are now considered moderate, rather than high.

Corrosion and pitting: Dissolved oxygen in the feed water is the principal cause of corrosion in boilers. Methods of oxygen control are both mechanical and chemical. Deaerating heaters will remove oxygen, if properly designed and operated, almost completely, and will reduce carbon dioxide. In most cases, however, it is necessary to follow up with chemical treatment. Inorganic sulfites, colloidal iron, tannins, and other organic chemicals are employed. Sulpho glucosates, which remove oxygen by both chemical reaction and by physical adsorption, do not require the maintenance of as great an excess of chemical as does sodium sulfite, and in addition help control scale. When oxygen control is difficult, due to air infiltration, as in many heating systems, film inhibitors such as the chrom glucosates are used. Corrosive salts, particularly magnesium chloride, in the boiler water, will often cause corrosion even in the absence of oxygen. The use of silicates to form coatings in boilers is not to be recommended generally, as the tendency for silica to form scale is increased.

*D. W. Haering & Co., Inc.

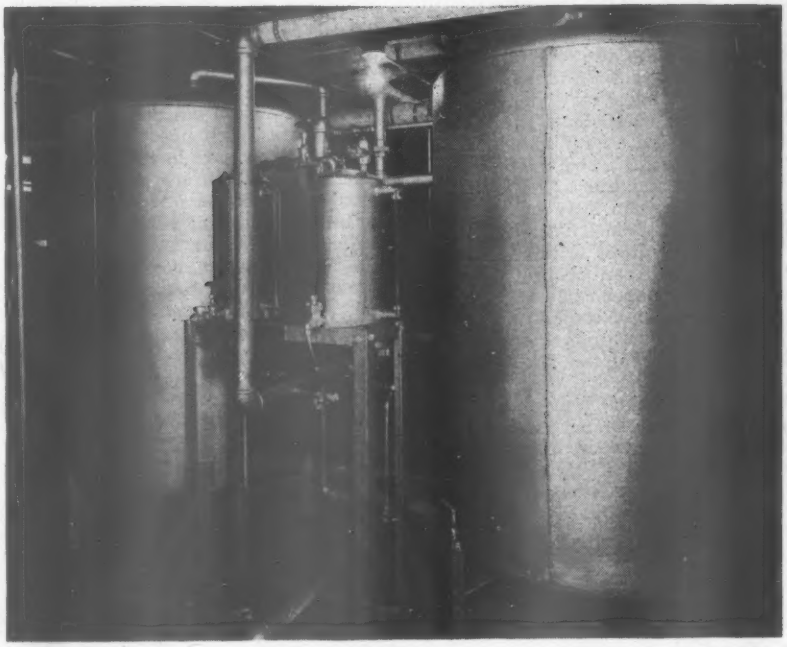

Fig. 1—A modern type (H-O-H feeder) unit, installed along with two zeolite softeners, to control corrosion and scale

Priming and foaming: Uneven steam generation due to fluctuating loads, small steaming surface and steam space, or high steaming rates may be responsible. Foaming is the building up of bubbles of steam, which fill up the steam space and go over into the lines. Soaps, oil, fine suspended particles, or other impurities in the boiler water make foams more stable. High water levels and high alkalinities, as well as high dissolved solids concentrations are to be avoided. Antifoam preparations are used in some cases, especially in locomotive boilers, with a fair measure of success. Bad foam conditions may cause difficulty in maintaining proper water levels in the boiler. Slugs of water in the steam may injure engines, turbines, superheaters, and may result in water hammer in the steam system. A careful study of water characteristics and of operating conditions is necessary to eliminate these troubles.

Caustic embrittlement: Intercrystalline cracks are often noticed in boiler plate metal near rivet holes or seams. Although some persons contend that these are the result of purely mechanical stresses, it has been pretty well proved that bad water conditions play a part in such failures of metal, which may be followed by violent explosions. Certain requirements seem to be necessary before this type of cracking can occur. The metal must be highly stressed, high caustic alkalinities must be present, and small leaks must be present to permit seepage of boiler water to permit its concentration in these crevasses to a point far beyond normal boiler-water concentrations. There is evidence to support the contention that silica must also be present in the water. The presence of comparatively large proportions of sulfates or chlorides in the water will usually prevent embrittlement. The A.S.M.E. sulfate-carbonate ratio idea of maintaining certain specified minimum

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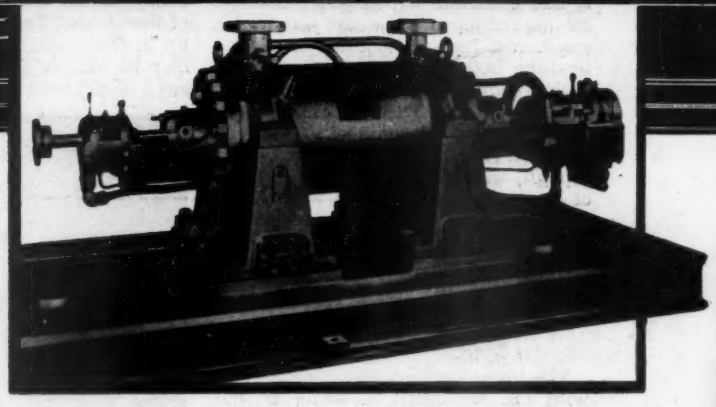

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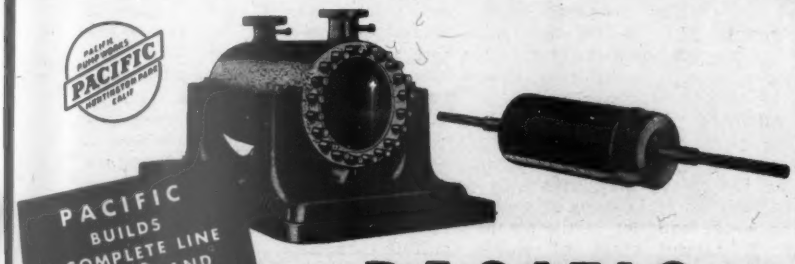

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ratios of sulfate to alkalinity has long been used. Some recent investigations seem to prove that this is far from infallible, and embrittlement fails to occur many times where these ratios are not maintained. Phosphates and other inorganic chemicals are used with considerable success, but recent investigations by the Bureau of Mines and others have demonstrated that certain organic materials are more effective and inhibit caustic embrittlement in much smaller amounts. In the author's experience, no cases of embrittlement have been reported in boilers where beta glucoside or its derived glucosates have been used. This experience extends over a period of years, and the operating conditions and water characteristics have been varied.

Oil in boilers: Oil is often a serious problem in boilers, causing poor heat transfer and tube failures. Oil in condensate from steam pumps, turbines, or engines, or from leaky oil heaters may build up in considerable amounts in boilers. The usual oil separators do not remove oil efficiently when it is emulsified in the water. Coagulation and filtration are often necessary. Severe oil conditions can often be controlled merely by internal treatment with organic colloids. One particularly bad condition which was remedied by use of pyro glucosate might be mentioned here. The tubes in a water-tube boiler were so badly coated with a gummy oil deposit that use of kerosene along with turbining was necessary to clean them. Balls of black oil-saturated sludge, resembling asphalt, and ranging in size from that of a walnut to a baseball, were present in the drums. In several weeks after starting treatment, the tubes were clean, and the oil was contained in a small-grained sludge that could be removed by blowdown.

Vapor-Phase Treating

The previous discussions have dealt with the treatment of water in the liquid state. When water is converted to a true vapor state, such as superheated or dry steam, where no droplets of condensed water exists, severe corrosion is not usually found. However, when water vapor does condense, pitting and corrosion are very common. Return lines of heating systems, and those handling condensed process steam, often develop leaks within a period of weeks after installation. Such corrosion will occur even where careful determinations show no traces of oxygen. When oxygen is present, the corrosion rate is much greater.

Ammonia or lime, being alkaline, are sometimes used to reduce corrosion by pH adjustment. The control of pH is often difficult, however, and ammonia, in particular, if present in excess, will destroy certain types of copper alloys, in valves or condensing equipment. The chrom glucosates are being used as corrosion inhibitors, either alone or along with pH control, in many refineries for reducing corrosion on the oil side of condensing equipment, and in units utilizing steam for processing. Proportioning units, constructed to withstand or to overcome the internal pressures in these systems, have been perfected to insure the addition of the proper amounts.

Steam treatment: Whether we are treating hydrocarbon vapors or liquids containing water vapor, or steam generated for the usual purposes, we are actually still treating water. Treatment dosages are usually based on the composition and volumes of the water condensed from the vapors. The idea of injecting corrosion inhibitors into steam was suggested by the successful handling of a corrosion problem in a high-pressure gas system. These inhibitors are added in water solution, but the amount of water added to the steam is usually of a negligible amount. Where the percentage of returns is high, a large part of the chemicals added may be returned to the boiler, where they will replace some of the treatment usually added direct to the boiler.

Cases are on record where condensate lines required replacement every month or so before treatment of the steam. Test sections have stood up in these same lines for periods of months without showing any evidence of corrosion, when such chemicals as tetro phospho glucosate or other glucosates have been introduced into the steam.

There are many possible applications of this idea of treating steam in refineries and other industrial plants. Elimination of oxygen from boiler-feed water, reduction of the carbon dioxide content of steam by lime treatment or deaeration of the feed water, and other measures have reduced corrosion in some cases. However, as noted before, corrosion will occur with even small amounts of carbon dioxide in the condensate, and oxygen is often introduced into the condensate systems by leakage of air, particularly where a partial vacuum is carried. The inhibitors are introduced, using proportioning feeders, for best results.

Proportioning

For any chemical treatment to be effective, it is often necessary that it be introduced in amounts truly proportional to the flow or makeup. A number of reliable proportioners have been developed. Especially worthy of mention for such purposes is a series of feeders which are actuated by the differential pressure between two pilot tubes or orifices in the line which carries the liquid or gas. Since this differential pressure varies directly with the rate of flow, true pro-

(Continued on Page 209)

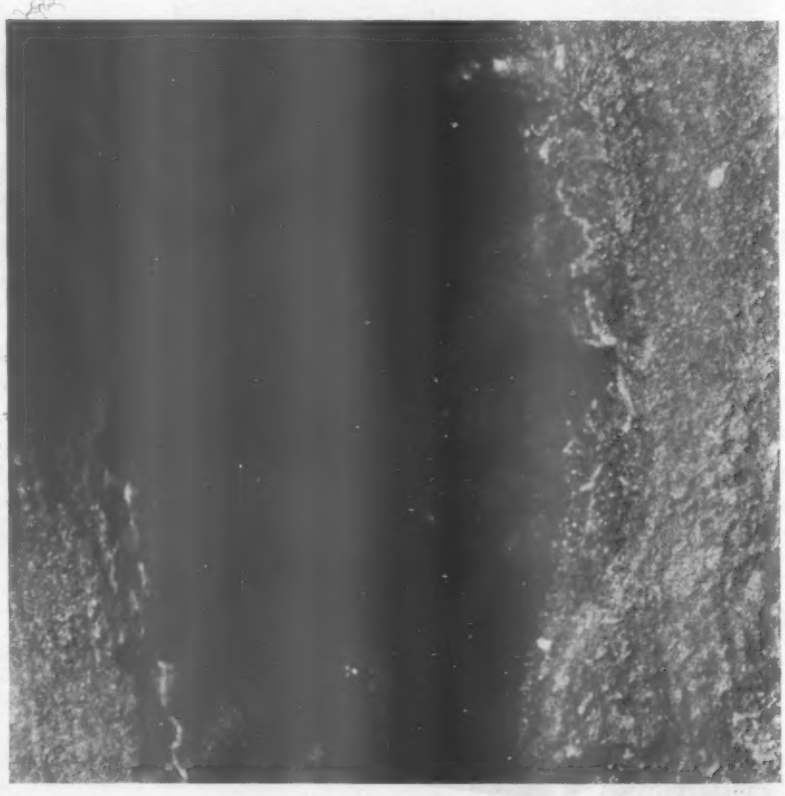

Fig. 2—A 1-in. deep corrosion pit in an engine-cooling system magnified

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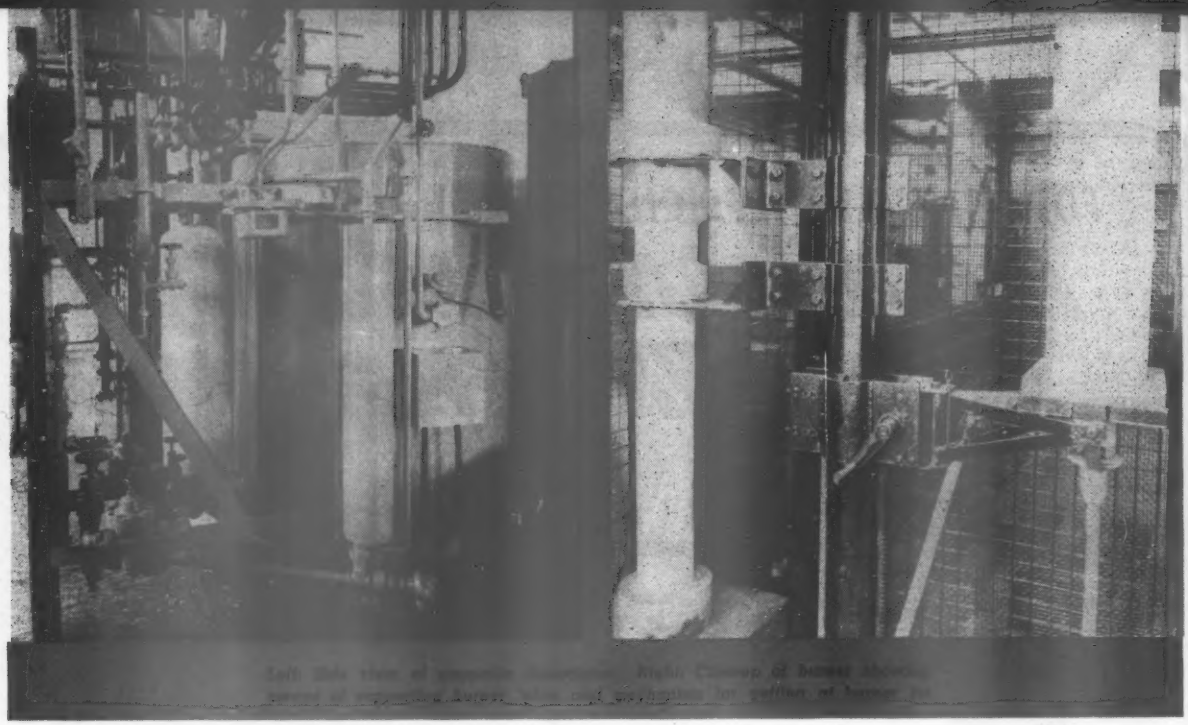
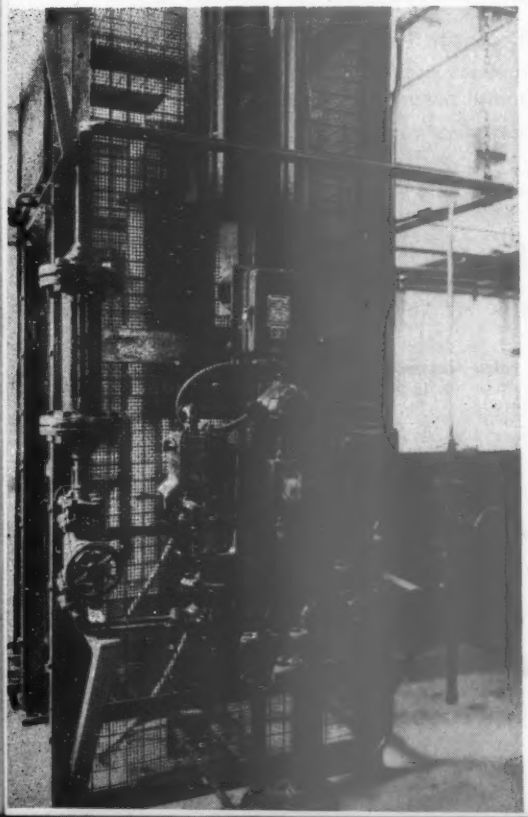


Plant MANUFACTURE of HCl For Use in ISOMERIZATION

View of burner protective screen showing flame arrester and solenoid valve for hydrogen stream on left side and flame arrester on right side.



TWO units have just been constructed for the manufacture of anhydrous hydrogen chloride, which is used as a promoter in the isomerization of normal butane—an important operation in the preparation of raw materials for the manufacture of 100-octane aviation gasoline.

One of these units was designed to produce 1,267 lb. per day, and the other 4,000 lb. per day of anhydrous chloride. These quantities were set such that the isomerization unit could be filled in approximately 48 hours, and the hydrogen chloride generation unit under normal conditions would have to operate approximately 1 day a week to make up for losses.

For use in the isomerization system, it was essential that a perfectly dry hydrogen chloride be obtained, free of oxygen, carbon monoxide, carbon dioxide, sulfur compounds and nitrogen compounds. Various processes were considered, among which were the reaction of sodium chloride and sulfuric acid, chlorination of hydrocarbons, drying of muriatic acid with concentrated sulfuric acid and direct combustion of chlorine with hydrogen, the latter being obtained either electrolytically or through purchase. The process finally used consisted of the combustion of dissociated ammonia vapors with gaseous chlorine and the extraction and drying of the hydrogen chloride from the resultant products. The decision to use this process was arrived at from economic considerations as well as from the fact that with this particular process there was no disposal problem of any byproducts such as the nitre cake formed in the reaction of sodium chloride and sulfuric acid.

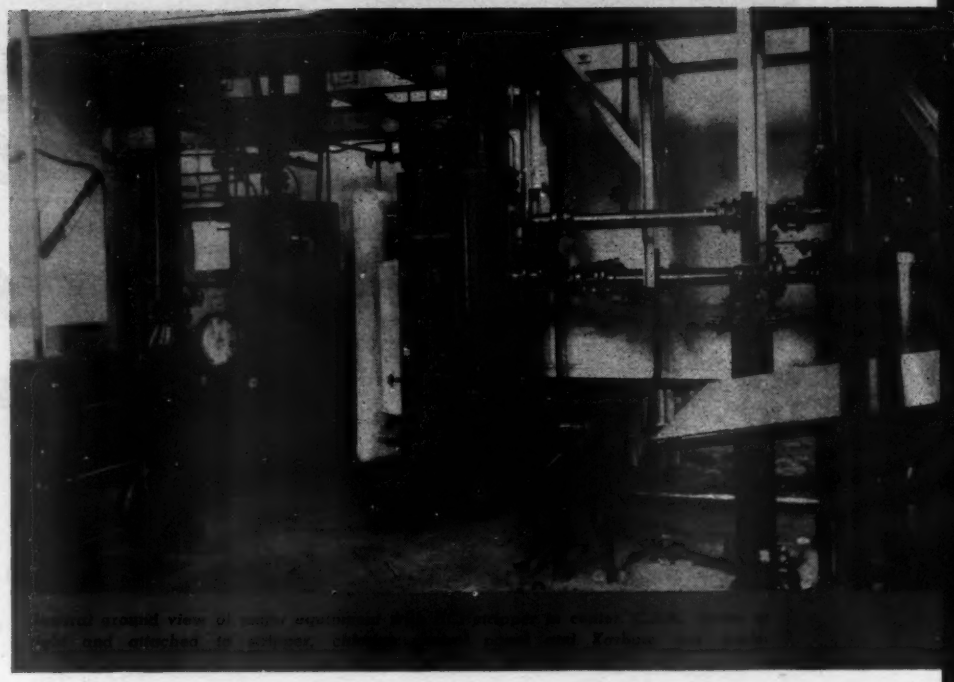
Essentials of Process

The simplified flow diagram given here illustrates the essential features in the process. Liquid chlorine obtained from 150-lb. cylinders in the smaller unit or 1-ton cylinders on the larger unit is vaporized in a steam-heated vessel and then flows to a control panel for metering, the rate of flow being adjusted by a ratio-rate-of-flow controller to give the required amount for mixing with the dissociated ammonia going to the burner. The ammonia to the unit is supplied from plant storage by a single steel line and immediately enters the ammonia dissociator. There, after heat exchange with the hot dissociated vapors, the ammonia is flashed from its high pressure on entering the unit to 8 lb. gage and enters the reactor chamber which is heated externally by electric resistance coils. In the chamber, aided by lump catalyst, the ammonia is "cracked" at 1,700° F. to nitrogen and hydrogen. Three volumes of hydrogen

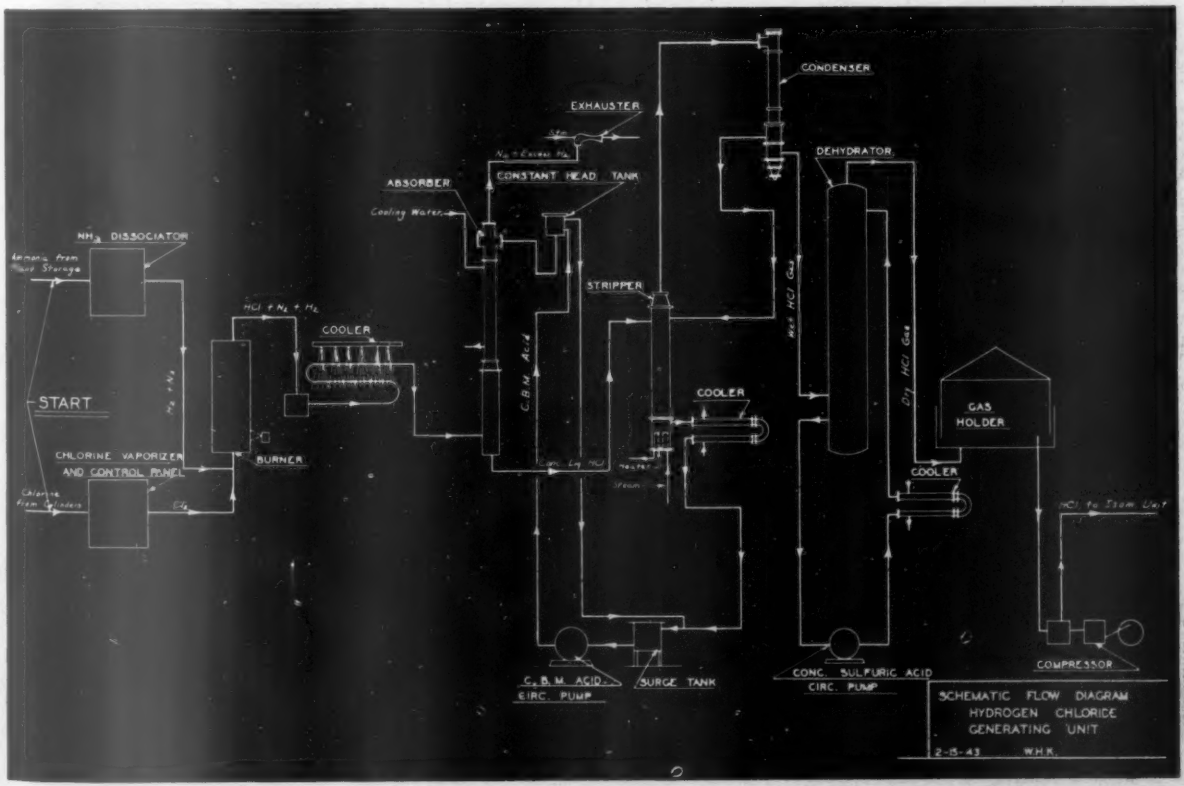
and one volume of nitrogen are formed for every two volumes of ammonia dissociated. The temperature and pressure are such that the outlet gases from the reactor contain only minute traces of unreacted ammonia. To make certain that the dissociator is operating properly, samples of the outlet gases going to the burner are tested hourly during operation to see that the amount of NH_3 in them is negligible. The hot reactor gases after heat exchange are water cooled and measured by a rotameter before being sent to the burner.

The chlorine is burned with the nitrogen-hydrogen mixture in an atmospheric-type burner, which is operated so that a slight vacuum is always maintained in the combustion chamber to keep the internal gases from leaking outside and thus creating a potential explosive or poisonous atmosphere. To further safeguard operation, the burner itself being friable is surrounded by a heavy metal screen to localize any possible explosion that might occur at that point. As an additional precaution a photoelectric mechanism was purchased which is set adjacent to the hot burner tube to actuate solenoid valves on both chlorine and hydrogen streams, shutting them off immediately in the event of flame failure. Chlorine and hydrogen unite with a blue-green flame, which has a theoretical temperature of 3,180° F.* When the pure

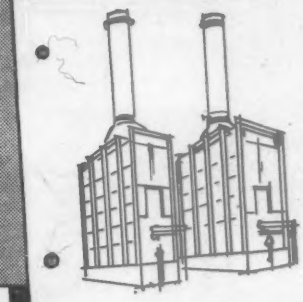
*Maude. Trans. A.I.CH.E. 38, 865, (1942).



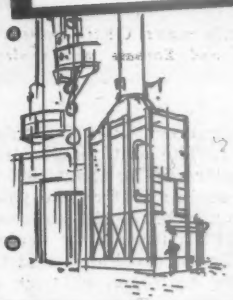
components alone are involved. The reaction products are first cooled by impinging on a small bath of hydrochloric acid in a pot constructed of a resin-impregnated graphite having excellent heat-transfer properties. The gases then pass on to a gas cooler where they are cooled by a film of water flowing down over the tubes of the cooler. The exit temperature from this cooler will be about 100° F. with 80° F. cooling water. The gases are thence conducted to the absorber. Here, by countercurrent flow against constant boiling hydrochloric acid (20 per cent), the hydrogen chloride of



Let's look at the RECORD



Twin Furnace Units for a D.P.C. Plant



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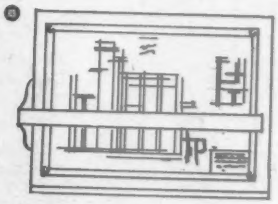

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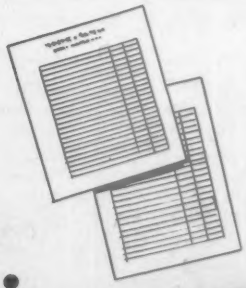

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the burner reaction products is extracted and the nitrogen together with excess hydrogen to the burner and any air leakage that may have accumulated are exhausted from the absorber and discharged through a glass steam exhauster into the outside atmosphere. Only a very slight excess of hydrogen is used to insure the complete combustion of all chlorine to the burner. The heat of solution of this hydrogen chloride in the absorber is taken out by water cooling through a metal jacket.

The metal used for the jacket has the very desirable property of being completely unaffected by the action of hot concentrated hydrochloric acid or of chlorine and can be manufactured in very thin tubes, thus giving high thermal conduction with reasonable structural strength.

The hot enriched hydrochloric acid from the absorber flows by gravity to the stripper where the enriched acid is stripped of its additional HCl and the constant boiling hydrochloric is cooled and sent to a surge tank. The heat to the stripper is supplied by steam inside of bayonet-tube heaters and the vapors rising from the stripper are condensed in a water-cooled condenser, with condensed acid flowing back to the stripper as reflux. The constant boiling hydrochloric acid is pumped to a constant head tank above the absorber, which receives the acid at a given rate governed by a variable orifice in the liquid outlet at the bottom of the constant head tank. The wet hydrogen chloride gas from the stripper now goes to a dehydrating tower where by countercurrent flow against concentrated sulfuric acid the water content is reduced to 0.0066 mol. per cent. The sulfuric acid is cooled after going through the tower and then returned to the top of the tower by a pump. The now-anhydrous HCl flows to an atmospheric gas holder where it is maintained at about 4 in. of water pressure for a short period of time over concentrated sulfuric. A compressor picks up the gas from the holder and discharges it under several hundred pounds pressure to the isomerization unit.

Various types of materials are used in the construction of these units to reduce the effects of corrosion from the acidic nature of the products handled. The main body of the absorber and stripper, as well as the lines handling hydrochloric acid or wet HCl gas, are constructed of an asbestos-impregnated resin of good structural durability and having great corrosion-resistant properties. The C.B.M. acid reservoir and the constant head tank are made of rubber-lined steel. The C.B.M. circulating pump is constructed of a high-silicon iron, and the sulfuric acid circulating pump of a high-chromium-nickel steel, both possessing great resistance to acid corrosion. To reduce chlorine corrosion most of the chlorine line from the outlet of the vaporizer to the burner is constructed of fine silver. Wherever steel is used for handling chlorine, gum pockets are installed to collect the tacky iron chlorides resulting from chlorine attack. In enlarged portions of the line, as the meter-orifice section, the inside is coated with a special corrosion-resistant paint. To protect the meter leads to the chlorine orifice flange, carbon tetrachloride is used as the sealing medium. Carbon tetrachloride is perfectly immune to chlorine attack as it is a fully chlorinated compound. Glass is used for the exhauster and also on the overflow-acid outlet from the evaporator pot in order to determine the acid level in that vessel. Steel equipment and lines are used for ammonia, dry HCl, and concentrated sulfuric acid services. To protect the steel structure of the building housing the equipment and also all exposed steel equipment in the unit, application of a corrosion-resistant paint is used.

The crown of the gas holder, which slides up and down in concentrated sulfuric, is protected by several coats of a corrosion-resistant paint.

Outside of the protection afforded the unit in using corrosion-resistant materials and paint, and safety measures, such as solenoid valves for the gases to the burner and screen around same, a very careful program is outlined and carried out by each plant to protect personnel against the toxic nature of the gases used and manufactured there. Each plant provides individual gas masks for every person coming in contact with the units and a special air-hose gas mask to be used in extreme cases where the area may become so flooded with gas as to make the canister-type inadequate. Special instructions are issued with all masks and all personnel so affected are thoroughly apprised of these.

Methylcyclopentane-Benzene Azeotrope

Presence of aromatics along with other hydrocarbons prevents the resolution of the different components of six and seven-carbon fractions of petroleum products by distillation methods alone, John Griswold and E. E. Ludwig report in an article in the January 1943, issue of Industrial and Engineering Chemistry. This fact is due to the formation of aromatic-paraffinic hydrocarbon azeotropes with peculiar volatility characteristics.

A mixture of methylcyclopentane and benzene—boiling 9.3° C. (16.74° F.) apart, form an azeotrope boiling at about 71.5° C. (160.7° F.) at approximately 90 mole per cent methylcyclopentane. Further purification of the cyclic compound must be done by other means.

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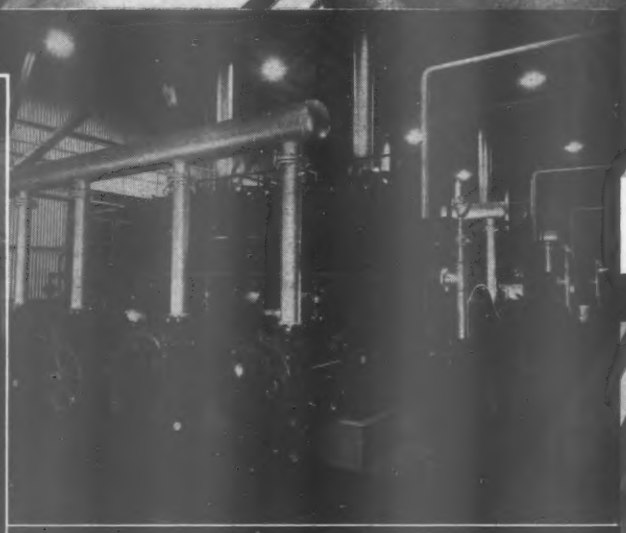

Two Clark 6-cyl., 3,000 H. P. steam-driven "Angle" Compressors and three Clark 8-cyl., 1,000 H. P. Supercharged Gas-Driven "Angle" Compressors in a California refinery.

Water Treating

(Continued from Page 200)

portioning is secured at all times. When flow stops, feeding stops. The use of the oil-piston arrangement insures sensitive operation at low flow rates. Another different type of unit is a plunger or piston pump, operated by pressures from the reciprocating pump handling the liquid through the line.

In dealing with water problems, in some cases, remedies are known when the causes are not completely understood. Minerals, dissolved by water from ground formations are deposited as scale in similar mineral forms. Metals, refined by metallurgical processes from their ores, corrode, and end up as oxides, sulfides, or other compounds. Algae and bacteria grow in much the same manner as other plant and animal life. Environment, which in the case of water problems, is made up of the water-using system and operating conditions, is often fully as important as the water characteristics, or as the type of algae and bacteria.

Scale Formation and Control

Although scale deposits as a rule include corrosion products, sand or silt particles, organic debris, or oil, scale usually is taken to mean material formed due to precipitation of substances originally present in the makeup water.

Calcium carbonate, resulting from the decomposition of the more soluble bicarbonate, constitutes the largest part of most scale deposits, Precipitation may occur at relatively low temperatures particularly if calcium bicarbonate is present in considerable quantity. Deposition ordinarily begins at about 130° F. and at 180° F. may become rapid. Magnesium carbonate will also deposit, but ordinarily in much smaller amounts. Magnesium hydroxide is only slightly soluble, and magnesium is often found in scale in this form. Calcium sulfate may deposit in several forms, depending on conditions. It results in a hard dense scale, difficult to remove either by acidizing or by mechanical means. Silica scale may be in the form of silicon dioxide, as silicates of calcium, magnesium, or iron, and in complex compounds resembling zeolites in composition. Silica scale is as a general rule harder and more dense than calcium sulfate deposits. Corrosion products sometimes constitute a large part of a scale deposit, particularly where a soft makeup water is used. Scale analyses usually show most or all of the above substances in varying percentages. Phosphates are usually found in scale where sodium phosphate treatments are employed.

If the surface on which these particles settle is at a high temperature, they may bake on to form a hard scale, rather than a sludge. Oil or algae may play a part in causing adherence of particles which would otherwise remain suspended. The tubes in closed heat exchangers, low banks of flues in fire-tube boilers, water tubes of boilers, and engine and compressor jackets are favorite spots for sludge to accumulate and to bake on.

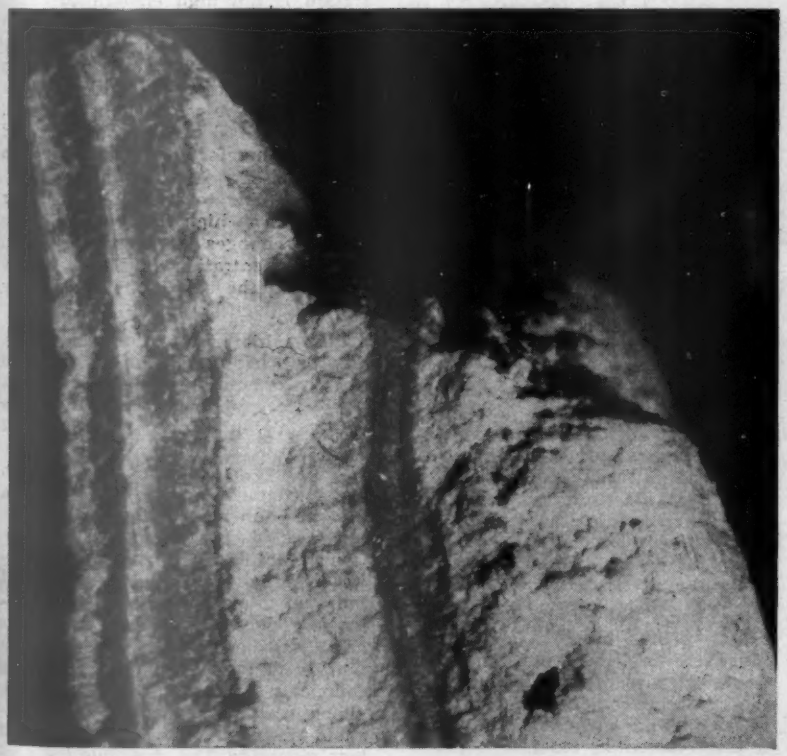

Fig. 3—Scale from an engine jacket approximately ½-in. thick. Note stratification of deposit, caused by varying conditions of deposition

Methods of Combating Scale

Zeolite and base exchange: The zeolite process is fairly well understood. When water passes through a bed of zeolite, the calcium and magnesium ions in the water replace the sodium ion in the zeolite. The effluent will therefore be free from hardness due to calcium and magnesium salts. The zeolite bed is regenerated with sodium chloride brine by a reversal of the softening reaction.

Zeolite softening serves the purpose admirably in some cases, and has certain disadvantages in other instances. The effluent will usually be high in sodium bicarbonate, and concentrations of alkalinity will tend to build up rapidly in boilers and some cooling systems. The amount of dissolved solids is not decreased by zeolite softening, and this is a disadvantage in most cases. The high alkalinities that build up in boilers may lead to caustic embrittlement, and the high alkalinities and high dissolved solids may cause foaming and carryover from the boilers. A high blowdown rate is usually necessary. Waters containing oil, iron, manganese, certain bacteria and suspended material, often cause trouble in zeolite units by forming coatings which interfere with softening or with the flow of water. Control is fairly simple, soap tests for hardness being used. The cost for treating 1,000 gal. of 20-grain water would be about 6 cents, taking an average figure.

New base-exchange materials: In recent years, new types of base-exchange material have been produced which have certain advantages compared with natural or manufactured zeolites. These base-exchange or ion-exchange materials are of an organic nature, and may be regenerated with salt, acids, or alkalies. When using salt for regeneration, the effluent is the same as with ordinary zeolites. If dilute acid is used for regeneration, the resulting water will contain free acids from the bicarbonates, chlorides, and sulfates in the water. The calcium, magnesium, and sodium ions are held by the exchange material, in this case called hydrogen zeolite.

Negative ion exchange: Some of these new materials, resembling plastics or resins, may be regenerated with sodium hydroxide or sodium carbonate. If water previously passed through a hydrogen-zeolite unit is now run through a bed of the ma-

terial regenerated with alkalies, the bed of material replaces the acid radicals with hydroxyl ions, and pure water is formed. Thus the effluent, practically speaking, is distilled water.

Lime and lime soda: By use of lime, the hardness due to calcium bicarbonate and to magnesium salts can be largely removed. In actual practice, most of the calcium bicarbonate is precipitated as calcium carbonate, and a part of the magnesium as the hydroxide.

The hardness not removed by simple lime treatment may also be removed by the use of soda ash along with the lime. Where salt is cheap, the zeolite process would be the more economical, but would require additional equipment. The use of pressure filters is customary with both lime and lime-soda processes, as is the use of coagulants, such as iron and aluminum compounds, and phosphates. The hot process, as compared with the cold process, gives more complete hardness removal, faster reaction and settling.

Acid treatment: Sulfuric acid treatment in cooling water is used principally to convert calcium bicarbonate to sulfate. In boiler-feed water, it will reduce alkalinities, and also increase the sulfate-carbonate ratio, thus reducing chances for caustic embrittlement. Its use often leads to severe acid corrosion, either by increased carbon dioxide content, or by an excess of the acid. Very careful control of alkalinities and dissolved solids is necessary to prevent undue corrosion, and calcium sulfate and silica scale.

Colloidal treatments: To prevent scale, tannins and starch have been employed with some success. The general theories underlying the use of the various products of this type hold true for all, but they vary in some properties and in effectiveness. Haering describes a series of such compounds, derived from beta glucoside. By substitution or condensation reactions glucosates are formed, which chemicals are found valuable in boilers, cooling systems, steam and return systems, etc. Since they can usually be used without installation of more than minor equipment, their use is particularly indicated under present conditions.

In preventing scale, the "cunctation" effect results in delaying precipitation of scale encrustants. When scale solids are precipitated, their nature is so altered that adherent crystalline scale is not likely to result. Also, oil is adsorbed, corrosion is retarded or prevented, and with the proper colloids, algae and bacteria may be controlled.

Dosages from 2 to 20 p.p.m. are used ordinarily. This would be 1 lb. to 6,000 to 60,000 gal. of water.

Phosphate treatments: Sodium phosphates are used internally in boilers, sometimes following zeolite, lime, or lime-soda treatment, to prevent scale. Certain new types of phosphates, available commercially, are helpful in holding calcium in solution, and are used to prevent scale. They also are used to control pH in various system waters, and to prevent caustic embrittlement in boilers. They have some value as corrosion inhibitors. Pyro glucosate, tetra phospho glucosate, and hemi phospho glucosate are derivatives of beta glucoside which combine the advantages of inorganic phosphates and organic colloids.

Miscellaneous treatments: The foregoing discussions cover most of the treatments most commonly used, but it would be well to mention a few others. Evaporators are used to furnish water of high purity for makeup for boilers, especially those operating at very high pressures. Internal treatments are usually required to complete the treatment, however.

Corrosion

Carefully prepared estimates show the annual loss in this country due to corrosion of ferrous metals alone amounts to about $100,000,000. Of this total, the petroleum industries suffer an annual loss of $35,000,000. Corrosion also is responsible for loss of production, extra labor needs, and for many serious accidents.

Electrochemical corrosion: This is the type most generally involved in corrosion of metal in aqueous solutions. Corrosion proceeds through the agency of corrosion cells, each of which is made up of a metal or alloy in contact with an aqueous solution. The anode of these cells is the point where the current setup leaves the metal, carrying with it metal atoms. the cathode is the point or area where this current leaves the water solution and reenters the metal. Metal will therefore tend to dissolve at the anode and deposit at the cathode.

Oxygen concentration cells: This is a specific type of concentration cell, due to oxygen distributed unevenly through the solution. The anodes of these cells occur where oxygen is deficient. Oxygen concentration cells may exist where breaks or crevasses in the scale or other coating or metal permit entrance of the solution, but do not permit ready diffusion of oxygen. Here the protected area under the coating acts as the anode of the cell. The corrosive action is concentrated at a few points, rather than generally distributed.

Ionization and dissociation: For corrosion cells to occur, it is necessary that there exist the positive and negative electrodes previously mentioned, that the cell components be capable of conducting a current, and that a solution potential exist.

Hydrogen Plating: Hydrogen has a zero potential with respect to metals. It behaves very much like metals in solutions, and metal ions will replace H-ions, the H-ions then migrating to the metal surface and plating out, changing from the ionic to the molecular state.

Polarization: If the film of hydrogen is undisturbed, corrosion will gradually cease, the cycle repeating itself only so long as the potential is high enough, and so long as nothing interferes with migration of the ions. If the atomic hydrogen film completely covers the metal surface, and is undisturbed, a counterpotential or electrical back pressure develops and balances the forces causing the corrosion, stopping it.

Hydrogen overvoltage: This force is characteristic both of the metal surface and of the corroding solution. Metals, such as very pure zinc, which have a very high overvoltage, will resist corrosion even by moderately strong acids because of the difficulty of molecular hydrogen formation on the surface. Iron has a comparatively low overvoltage, and carbon even less.

Oxygen depolarization: If molecular hydrogen is not formed, oxygen dissolved in the water may combine with atomic hydrogen to form water, thus depolarizing the metal and allowing corrosion to progress. For this reason, in many cases of corrosion, the rate is proportional to the oxygen content of the water. In neutral and alkaline solution, the H-ion concentration is not high enough to cause sufficiently rapid corrosion of iron by hydrogen evolution, and therefore depends on the oxygen concentration and the ease of oxygen travel from the body of the solution to the metal surface. Agitation of the solution and aeration therefore accelerate oxygen corrosion.

Erosion due to entrained gases or solids, and to high flow velocities, as well as changes in temperature and in the concentrations of dissolved substances in the solution, may destroy the effectiveness of the films.

Film inhibitors: Certain chemicals, notably chromium compounds and certain organic materials, have the ability to lay down protective films on the metal, of such a nature that corrosion is retarded or prevented. To be effective as corrosion inhibitors in water, chemicals must produce a film that has adherency, stability, that is self-healing, and nonporous. In addition the inhibitor must have the ability to remove scale, and must not build up to an extent that heat transfer is reduced. Inorganic chromates have long been used in this connection, alone or together with organic chemicals. The chrom glucosates, which may be considered to be organic chromates, are derivatives of beta glucoside. The chromate ion provides adherency, and the organic structure provides high coverage,

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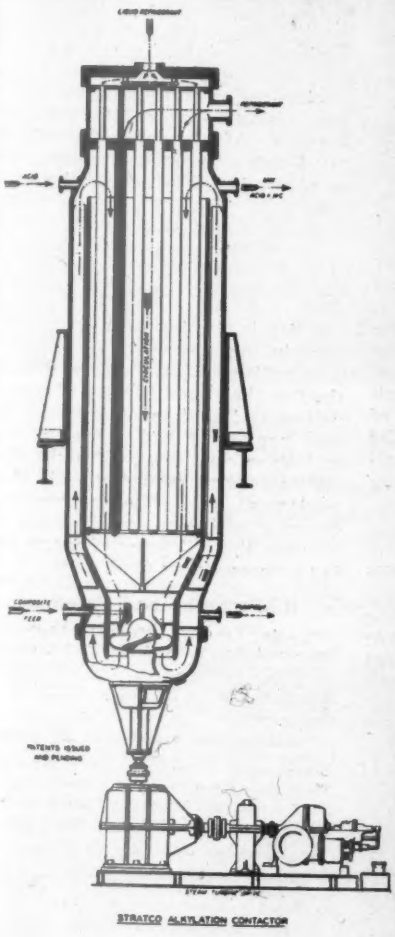

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elasticity, stability, and scale removal and prevention properties. The films are extremely thin, and do not build up sufficiently to interfere with heat transfer.

Sodium chrom glucosate is employed where a slight acid condition may exist. Quachrom glucosate may be used under average conditions. Ferri chrom glucosate is of most value where a fairly high acidity exists. Cupric chrom glucosate is used in cases where algae or bacteria are present, and need to be controlled.

On iron and steel surfaces, the chrom glucosate films are adsorbed as iron chrom glucosate, while on copper alloys, no direct action on the copper takes place. These organic chromates are effective in much smaller concentrations than the inorganic chromates. Costs are less, and less strategic chromium is required.[2]

Electrolysis: This term is usually understood to mean solution of metal that results from electric currents entering a system from external sources. Stray currents in the ground, and improper grounding of electrical equipment are usually responsible. Inhibitors will usually reduce this type of corrosion, but the cause should be found and eliminated.

Graphitic corrosion: Carbon, which we mentioned before as having a very low overvoltage, is present in cast iron, graphitic packings and gaskets, or as slag inclusions in metal. This carbon may accelerate corrosion, particularly in slightly acid solutions. Hydrogen sulfide often accelerates this type of corrosion.

Dezincification: In this type of corrosion, the entire metal dissolves, but the copper is redeposited at the point where solution is taking place. This porous copper deposit will eventually penetrate the metal.

Hydrogen sulfide: If oxygen and moisture are present long with hydrogen sulfide or other corrosive sulfur compounds, corrosion may be very rapid. Hydrogen sulfide is particularly corrosive to red brasses and bronzes, even when present only in traces. Decomposition of sulfates in water by certain bacteria will often cause its presence in the sludge in cooling tower basins and in ponds. The adjustment of pH with alkalies is sometimes beneficial, but the use of a corrosion inhibitor is usually called for.

Corrosion fatigue: If corrosion is accompanied by vibration or other alternating mechanical stresses, the endurance limits of metals can be materially reduced by the corrosion, and fatigue failure may occur. Caustic embrittlement in boilers may come under this type of corrosion. It is well known that embrittlement occurs more frequently in locomotive boilers, which are subject to considerable vibration, than in stationary boilers.

Algae and Bacteria

These organisms, of many kinds and descriptions, seem to be a growing problem in open cooling systems. Like other growing things, they seem to thrive more in sunlight and in warm weather. They are found in well waters, as well as in waters from rivers and lakes. Once started in a system, it is hard to eliminate them. Recontamination is likely, even when they have once been brought under control, because of the fact that they may be wind-borne. Also, they vary greatly in their resistance to the chemicals employed in attempts to control them, and may even develop a resistance to these chemicals.

Among the chemicals used for control, with varying results, are chlorine, chloramines, chlorinated phenols, hypochlorite, copper sulfate, chromates, permanganates, and other compounds. Cupric chrom glucosate has given satisfactory results in many cases, and combines corrosion control along with control of these organisms.

The beds in filters and zeolite softeners serve to catch these organisms on the surface where they may grow and increase pressure drop, as well as decreasing efficiency. Masses of algae debris may be carried into the passages in engine or compressor cooling jackets, and cause hot spots by interfering with water flow.

Cooling Systems

Heat exchangers and condensers: Although we are concerned mainly with heat-exchange units where water is used as the cooling medium, various other heat-exchange processes will be considered, since they have some connection with water problems. When an oil-to-oil exchanger becomes fouled, the hotter stream is not properly cooled, and a greater load is thrown on water-cooled units, for completely cooling or condensing the oils and vapors.

When heat exchangers or condensers are designed, certain more or less arbitrary figures are assumed for heat-transfer rates for the conditions of use and the types of metals employed. These figures are based on clean exchange surfaces, but a factor of safety employed allows for a certain amount of scale buildup. Many exchangers are improperly designed, or the units installed, because of the desire to reduce installation costs, may be too small for the job, except while clean.

Effects of scale on yields and operation: Wedell and Borst[3] reported an increase of 50 bbl. of gasoline per day in an 8,500-bbl. refinery, due to increased cooling efficiency which resulted when cupric chrom glucosate and tetra phospho glucosate were used in the cooling water. These chemicals replaced the previous treatment used which had not been satisfactory. Rohrdanz[4] gives some hypothetical calculations which illustrate the economy of properly conditioning cooling water. Reductions in production of natural-gasoline plants as high as 20 per cent have occurred due to poor heat transfer, particularly in cooling absorption oil. Reductions in oil temperatures as great as 75° F. have resulted when cooling and condensing units have been cleaned. In one refinery, on one of the condenser boxes serving a cracking unit, the differential between the ingoing cooling-water temperature and the outgoing gasoline temperature was about 9° F. at the beginning of a run when the submerged sections had been cleaned mechanically. This differential had been rising to over 20° F. early in the run. After treatment was instituted, this differential was held down to about 14° F. through the entire run.

Summary

An attempt has been made to survey, for the benefit of the busy plant man, the present-day theory and practice in dealing with water problems in the refinery.

Attention is particularly called to the fact that the difficulty of securing delivery of equipment does not warrant neglect of bad corrosion, scale, and algae conditions. Straight chemical treatment, requiring little if any equipment, will often get results efficiently and economically, and will increase the efficiency of many treating processes now used.

Bibliography and References

[1]Haering, D. W., "Organic Methods of Scale and Corrosion Control," 5th ed., 1943.

[2]Haering, D. W., "Film Inhibitors in Industrial Aqueous Systems," Industrial and Engineering Chemistry, Dec. 1938.

[3]Wedell, C. L., and Borst, W. B., "Increasing Production With Clean Condensers." Petroleum Refiner, Aug. 1942.

[4]Rohrdanz, R. C., "Economics of Water Conditioning for Scale and Corrosion Control," Petroleum Engineer, May 1942.

Speller, F. N., Corrosion, Causes and Prevention."

Evans, U. R., "The Corrosion of Metals."

Watts, "The Electrochemical Theory of Corrosion," Transactions of the Electrochemical Society, 34 (1933), p. 144.

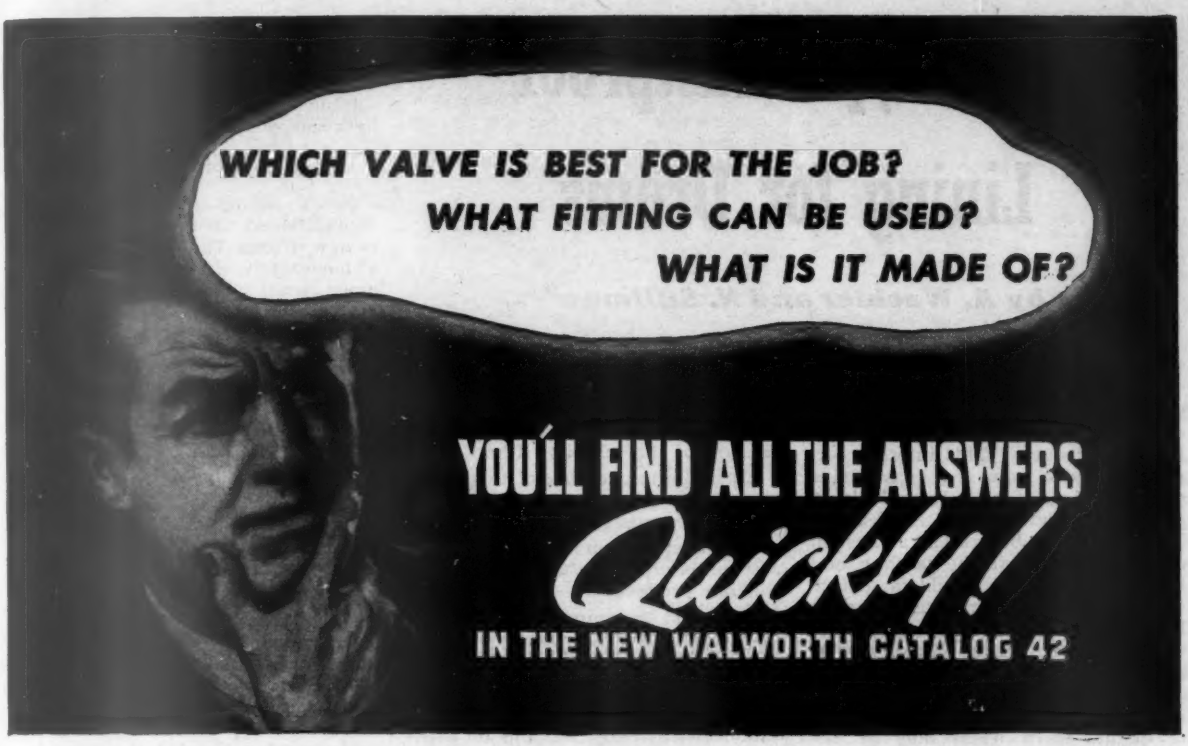
Powell, Sheppard T., "Boiler Feed Water Purification."

Ryan, W. J., "Water Treatment and Purification," McGraw Hill Book Co., 1st ed., 1937.

Crane Co., "Combating Corrosion in Industrial Process Piping," Technical Bulletin 408, May 1939.

Future Diesel Fuels

Diesel-engine designers and manufacturers are studying the present trend in utilization of middle fractions of petroleum in the effort to forecast the trend in diesel fuels and the availability of desirable fuels for compression-ignition engines. Introduction of catalytic cracking, employing these middle fractions may or may not complicate the future diesel-fuel problem.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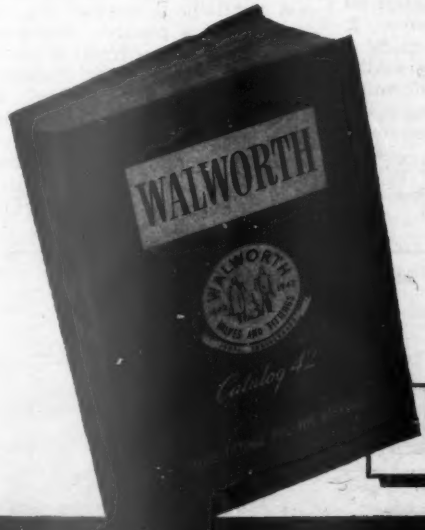

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New Type Rustproof Lining for Drums

by A. Wachter and N. Stillman *

FOR a long time the need has existed for some economic means of preventing corrosion of the interior of drums used as containers for light petroleum products.† This internal corrosion results from the unavoidable presence of moisture in the petroleum product as for example, in gasoline. The water may be present at first in complete solution in the gasoline, and later precipitate on the drum surface when atmospheric temperatures drop below the solution temperature (of the quantity of water dissolved), or precipitate from the vapor in the drum when the temperature falls below the dew point. In addition, larger quantities of water may be entrained in the gasoline with which the drum is filled. In the complete absence of oxygen, water alone would give rise to no practically significant corrosion; however, the gasoline is likely to be nearly saturated with air and air is present in vapor space of the filled drum.

When steel drums are used as containers for light petroleum products, serious contamination of the liquid may occur as a result of internal rusting. Even galvanized drums may be affected, forming white powdery zinc oxide. The problem is especially important in the use of drums for aviation gasolines, since traces of suspended matter in the gasoline are highly objectionable and storage under severe climatic extremes may extend over prolonged periods.

Water-Soluble Lining

In the investigation which led to the development of the new rustproof lining described later, a somewhat unconventional approach was followed. Many lacquer or baked-enamel linings have been proposed and considered for drum protection. Such coatings have the disadvantages of high cost, poor resistance to shock or severe impact, and contamination of product. In addition, they are not economically applicable to returnable drums already in use. They provide a continuous unbroken film over the steel, impervious to water. In principle, the new approach involved lining the drum with a nonflowing aqueous solution of an efficient rust corrosion inhibitor so that separation of small quantities of water from the gasoline would result merely in slight dilution of the inhibited film.

An inhibiting coating of this aqueous type must meet several requisites to be satisfactory.

1. It must contain a highly effective rust inhibitor, stable with various petroleum products.

2. It must be composed of materials insoluble in hydrocarbons.

3. It must have no adverse effects on petroleum products.

4. It must adhere to the drum wall and be sufficiently flexible to withstand extreme rough handling.

5. It must not be adversely affected even after prolonged contact with petroleum products.

6. The cost of coating drums must be sufficiently low to make its application economical.

Research along this line led to the development of a rust-preventive coating which has been given the name Nidex,* and which satisfies all of the requirements given above. It contains sodium nitrite which is a very effective and stable rust inhibitor,† a mucilaginous film-forming vehicle, a plasticizer, a wetting agent to ensure good coverage even over somewhat oily surfaces, and a dye to facilitate inspection of the lined drum. All of these constituents are soluble in water and insoluble in hydrocarbons.

Application of Nidex to Drums

Nidex linings can be applied to reconditioned used drums as well as to new drums. The coating will cover a moderately dirty, rusty, oily, or moist drum surface. No preliminary preparation of the surface would be required for new drums. Reconditioned used drums should be cleaned at least to the point where insufficient old oil remains to flow or run over the drum surface, and to remove excessive deposits of rust scale. Returned Nidex-lined drums should be cleaned and relined.

In essence, the application of Nidex to drums involves spraying an excess of the aqueous solution into the drum, allowing time for draining, removal of the accumulated drainings, and evaporation of the water solvent. The manner in which this may be accomplished is indicated in the simplified flow plan given in Fig. 1. The flow plan shows a small working solution tank with a volume capacity sufficient for about 1 day's production. The Nidex solution is used at atmospheric temperatures. It is considered that a residence time of about 30 seconds for a drum on the sprayer, using 3 gal. per minute, would be adequate. After the drum is removed from the spray nozzle, it must be given sufficient time, about 4 or 5 minutes, for the excess to drain down to the bottom. Then the pool of excess solution is sucked out of the drum with a positive displacement-type pump and returned to the working solution tank. The draining time is obtained without creating a bottleneck in the rate of production by placing all of the sprayed drums in single file line and applying the suction only to the last drum in the line.

(Continued on Page 219)

*Shell Development Co., Emeryville, Calif.

†M. G. VanVoorhis, Natl. Petroleum News, Vol. 33, No. 18, R-130, April 30, 1941.

*Application has been made for a U. S. patent.

†A. Wachter and S. S. Smith, Ind. Eng. Chem., 1943, to be published soon.

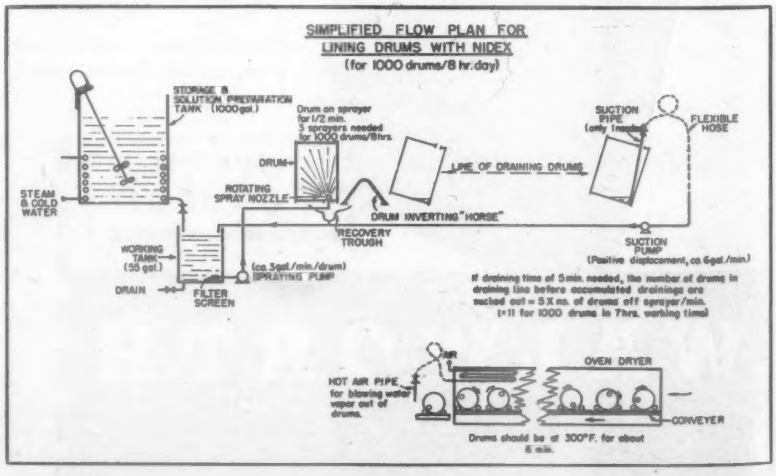
SIMPLIFIED FLOW PLAN FOR
LINING DRUMS WITH NIDEX
(for 1000 drums/8 hr. day)
STORAGE & SOLUTION PREPARATION TANK (1000 gal.)
Drum on sprayer for 1/2 min. 3 sprayers needed for 1000 drums/8 hrs.
DRUM
LINE OF DRAINING DRUMS
SUCTION PIPE (only 1 needed)
FLEXIBLE HOSE
STEAM & COLD WATER
ROTATING SPRAY NOZZLE
DRUM INVERTING "HORSE"
RECOVERY TROUGH
SUCTION PUMP
(Positive displacement, ca. 6 gal./min.)
WORKING TANK (55 gal.)
(ca. 3 gal./min./drum) SPRAYING PUMP
DRAIN
FILTER SCREEN
If draining time of 5 min. needed, the number of drums in draining line before accumulated drainings are sucked out = 5 X no. of drums off sprayer/min. (=11 for 1000 drums in 7 hrs. working time)
OVEN DRYER
HOT AIR PIPE for blowing water vapor out of drums
CONVEYER
Drums should be at 300°F. for about 5 min.

Fig. 1

Rustproof Lining

(Continued from Page 214)

The drying step should be continued long enough to obtain a nonflowing lining, that is, one which cannot be wiped off by simply running a finger over the surface. However, the upper limit of drum metal temperature, which should not be exceeded after the coating is applied, is 350° F. for 10 to 15 minutes.

It has been found that from 20 to 25 drums can be lined with 1 gal. of Nidex solution. If the drums are to be closed with cast iron or steel bungs, these also must be coated.

Tests Duplicate Service

A large number of laboratory tests were made under a variety of conditions simulating extremes of possible service conditions. A representative group of these tests is summarized below.

Prevention of Corrosion. The coating must prevent the formation of powdery corrosion products even under drastic conditions of use.

Several corrosion tests were made with coated and uncoated drum iron strips. The test strips, held under 100-octane aviation gasoline, were sprayed equally with small droplets of 0.05 per cent NaCl solution and allowed to stand for 4 days. The uncoated strips showed definite signs of rust in less than an hour after the drops were applied and all developed pronounced rust blisters at each droplet. None of the coated strips showed any sign of rusting. The result obtained with a half-coated strip which was sprayed with dilute salt solution equally on the coated and uncoated parts is illustrated in Fig. 2.

Fig. 2—Corrosion test with drum iron strip half coated with Nidex. Uncoated and coated parts were sprayed equally with small droplets of 0.05 per cent NaCl aqueous solution under 100-octane leaded aviation gasoline and allowed to stand for 4 days

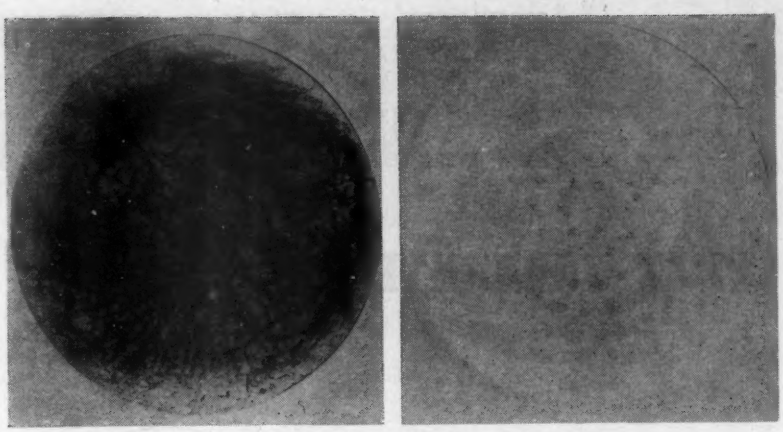

Fig. 3—Effect of Nidex in preventing contamination of paint base spirit by rust from reconditioned black iron drums. Picture at left shows rust filtered from sample of unlined drum. Picture at right is of a filter paper showing sediment in sample from Nidex-lined drum

Several tests were made with Nidex-lined and unlined 1-gal. black iron drums containing 100-octane leaded aviation gasoline. A lined drum and an unlined drum were filled with the gasoline, 0.3 ml of distilled water was sprayed into each, and the sides dented deeply. Every night the drums were surrounded with dry ice, and throughout each day for 8 hours a temperature of 100°-105° F. was maintained with steam coils. After 7 days of this treatment, the gasoline from the unlined drum showed considerable rust contamination, whereas the gasoline from the lined drum was completely free from sediment. The interior of the unlined drum showed general rusting and many large rust blisters, while no rust could be detected in the lined drum.

It is estimated that a Nidex-lined 55-gal. drum will contain sufficient sodium nitrite to completely inhibit at least 1 gal. of added water.

Gasoline Contamination Tests. It is essential that any drum lining for petroleum products be insoluble in hydrocarbons, and have no adverse effects on the specification properties of the contained liquid. From the nature of the constituents of Nidex there is no reason to suspect that any harmful effects would result from contact with the usual petroleum products, however, to obtain direct evidence a number of experiments were made.

Solubility tests made separately with sodium nitrite, with the mucilaginous vehicle, and with the plasticizer showed that each was insoluble in gasoline and did not affect gum content

Gum tests made on different products after contact with the complete Nidex-lining gave no increase in gum content even after storage at elevated temperatures, as shown by the results summarized in Table 1.

An accelerated storage test was made by refluxing 1 gal. of 25/75 mixture of benzene and gasoline in a steel can that had been lined with Nidex. The can was fitted with a reflux condenser and heated on a hot plate. After 24 hours, samples of the refluxed mixture and a reference sample were analyzed for nonvolatile residue. No significant difference was found.

Shock Resistance. A number of tests were made in which small pieces (2 by 2 in.) of 20-gage cold-rolled sheet steel were subjected to impact deformation by a hammer, the striking face of which consisted of a ¼-in. diameter rod rounded at the end. The blow was made on the uncoated side, and its force was adjusted to give maximum deformation of the test piece without perforation. Corrosion tests on the deformed pieces were made by placing a drop of 0.05 per cent sodium chloride in distilled water on the apex of the indentation and then covering with gasoline. Those pieces which had been coated with Nidex showed no sign of film failure after deformation and gave no detectable indication of rusting after several days in the corrosion test.

TABLE 1

Gum Tests after Contact with Nidex

Conditions: Three 1-qt. bottles lined with Nidex and filled with different products stored for 7 days at 120° to 140° F. Reference samples of each product retained in unlined containers.

Product—	A.S.T.M. Air Jet Gum, mg./100 ml.	
	Reference sample	Nidex contacted
100 O.N. leaded aviation gasoline	1.0±0	0.5±0.1
Cracked gasoline	3.4±0 (dark straw color)	2.5±0.1 (light straw color)
Benzene	0.8±0	0.4±0

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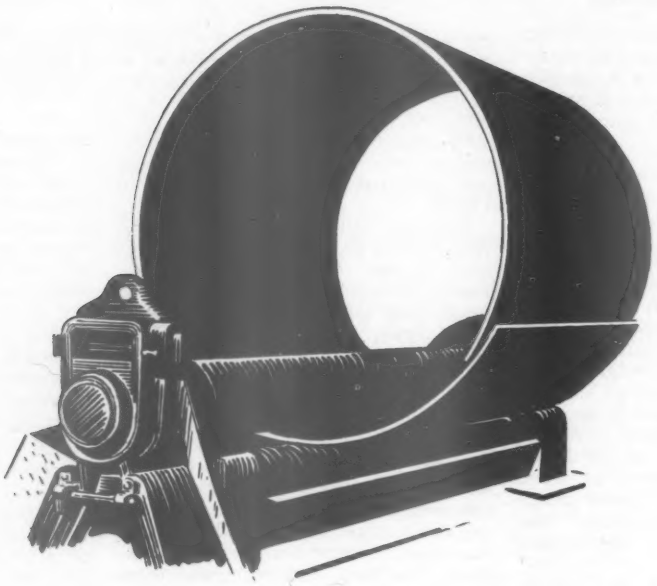

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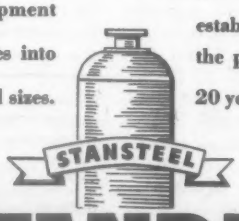

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Abrasion Resistance. Laboratory experiments to test the resistance of Nidex to abrasion were made as follows:

Polished steel strips ⅜ in. by 5½-in. were coated with Nidex, were placed in 8-oz. wide-mouth bottles, and to each bottle 100 grams of 48 to 65-mesh white sand and 100 ml. of gasoline added. The cork stopper in each bottle was pushed in to wedge the strip firmly in place. The bottles were rotated end-over-end at 60 r.p.m. for 24 hours. The strips were then removed, particles washed off with gasoline, and dried. The Nidex coating showed evidence of some surface abrasion, but the coating was continuous.

A corrosion test was made with the abraded strips as follows. They were cut into 2-in. lengths, placed flat in the bottom of small jars, and covered with 150 ml. of an emulsion of water in gasoline. The emulsion was prepared by vigorously shaking 25 ml. of 0.05 per cent sodium chloride in distilled water with 500 ml. of gasoline, letting it stand for 1 minute before pouring out the 150 ml. for the corrosion test. Inspection of the strips after 64 hours showed no rust on the Nidex-coated strips.

To demonstrate the ability of the Nidex film to prevent rusting even when small discontinuities or pinholes exist in the coating, the following scratch test was made. Bright, 2 by 2-in. squares of cold-rolled sheet steel were coated with Nidex. A grid of lines was scratched through the coating to the underlying steel with a fine needle, thus outlining ¼-in. squares. The test pieces were then placed scratched face up in the bottom of a jar and covered with 150 ml. of an emulsion of 0.05 per cent sodium chloride in gasoline as described under the abrasion test. After 66 hours no rust was found on the Nidex-coated pieces.

Resistance to Gasoline. The following tests were made in the laboratory. Nidex-coated pieces (2 by 2 in.) of 20-gage cold-rolled sheet steel were subjected to impact deformation as described under shock resistance. The dented pieces were then suspended in refluxing benzene for 48 hours, after which they were subjected to the solution drop corrosion test described under shock resistance. Nidex-coated pieces showed no sign of rusting after 69 hours exposure.. These experiments were repeated subjecting the coated pieces first to refluxing benzene and then to impact. Corrosion test results were similar to those obtained with the reversed procedure.

In the test previously described, in which a Nidex-lined can was subjected for 24 hours to refluxing benzene, observations were made on the condition of the lining after the test. The lining showed complete continuity, adherence was not changed and pliability was not impaired. Supplementary observations on these properties were made on Nidex-coated strips suspended in a relfuxing mixture of benzene and gasoline. One half of the specimen was immersed in the boiling liquid, the other half exposed to the vapor. Here, too, no change in properties was observed. Absence of weight loss by the test strips in this experiment gave additional evidence of stability.

Nidex-coated steel strips immersed in pure benzene and in a cracked gasoline at 120° to 140° F. for 7 days showed no loss in flexibility or adherence of the film and no rusting in subsequent water-drop corrosion tests.

Temperature Effects. Several tests of Nidex coatings at elevated temperatures have already been described. An experiment in which coated strips were exposed to dry air at 120° to 140° F. for 7 days showed that the coating suffered slight decrease in tackiness, was otherwise apparently unchanged. Extreme bending tests showed no cracking or flaking. Water-drop corrosion tests under aromatic solvent gave perfect results, no rusting.

A test under high-humidity conditions was made in which Nidex-coated steel strips were suspended over a large dish of water in a small cabinet at 120°-140° F. for 8 hours. Then the strips were removed and suspended in air at room temperature for 16 hours. This treatment was repeated for 7 days. The coating apparently is unchanged by this treatment.

Service Tests

Field trials* of the Nidex lining in 55-gal. steel drums with different fuels gave entirely satisfactory results with both new and washed rusted old drums.

In one trial, new and used drums which had been lined with Nidex were filled with aviation gasoline, with a paraffinic and an aromatic light solvent, and with a diesel fuel. Comparable unlined drums were filled with the same products. Immediately after filling, 5 ml. of distilled water was sprayed into each drum. The drums were then stored in the open, were loaded on a truck once weekly, carried around for 2 hours, and were inverted after each trip. After 2 months, analyses of the fuels from the Nidex-lined drums showed no change in specification properties such as color, clarity, odor, A.S.T.M. gum, A.S.T.M. distillation, and octane number. Equal-volume samples taken from each drum after vigorous shaking, were filtered through paper to compare the amounts of suspended matter in each. Considerable rust was obtained from those products which had been stored in the unlined drums, especially the old ones, whereas the products from the Nidex-lined drums gave insignificant amounts or none at all. Since the old drums used in this test were rusted internally, these results demonstrate another important function of a Nidex lining, namely that of binding scale and dirt to the walls so that rough handling of the drum during transit or use does not detach the scale and thus contaminate the fuel.

An example of the comparative amounts of sediment obtained on filter paper from equal volumes of a product from reconditioned steel drums, one Nidex-lined and the other unlined, is illustrated in Fig. 3.

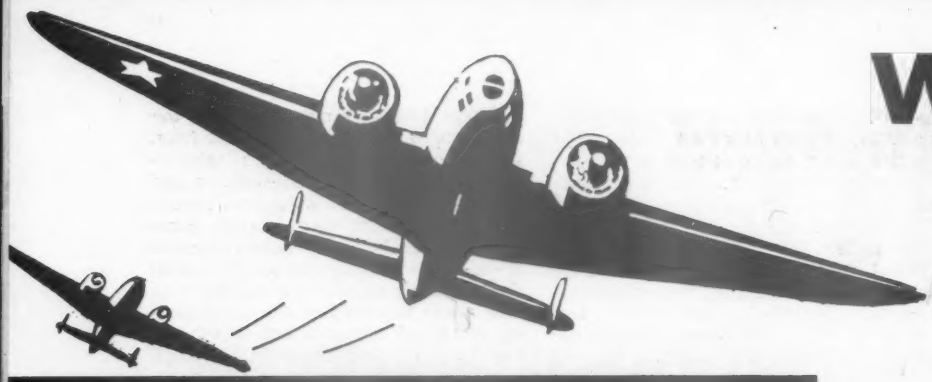
*With the cooperation of Shell Oil Co., Inc.

Limitations on General Use

Although Nidex is an excellent rust-preventive lining for steel drums containing the common petroleum fuels and solvents, the nature of its constituents impose several limitations on its general use. Since the inhibitor, sodium nitrite, is not effective on zinc, the lining gives no protection in galvanized containers. Also, because the inhibtor is useful on steel only under neutral or alkaline conditions, the lining cannot be used with strongly acidic liquids or with products such as hydrolyzable esters or organic chlorides which give aqueous acids on standing in contact with water. Because the lining is soluble in water, it is not applicable for use with aqueous solutions or under any conditions which may expose the film to repeated washing with appreciable volumes of renewed water. For example, the lining would not be satisfactory in refinery storage tanks, because it would not only be rapidly dissolved by the water in the bottom of such a tank but this water would gradually be replaced by new uninhibited water. Nidex is essentially a "single trip" lining. If used in returnable containers, the lining will be removed by the internal wash and must be reapplied.

General Rust-Preventive Coating

As might be judged from the results already given, Nidex possesses properties which make it suitable as a general rust-preventive under certain conditions. It may be used for protection of stored or idle iron or steel in any finished shape or stage of fabrication. Since this coating contains an excellent inhibitor for the rusting of steel, condensation of moisture on the walls of the coated equipment or presence of drops of water will cause no rusting. However, because Nidex is soluble in water in should not be used when a large volume of water may flow over the coated surface and thus wash away the coating. For application of Nidex as a rust-preventive coating, a modified composition is used which dries relatively quickly.



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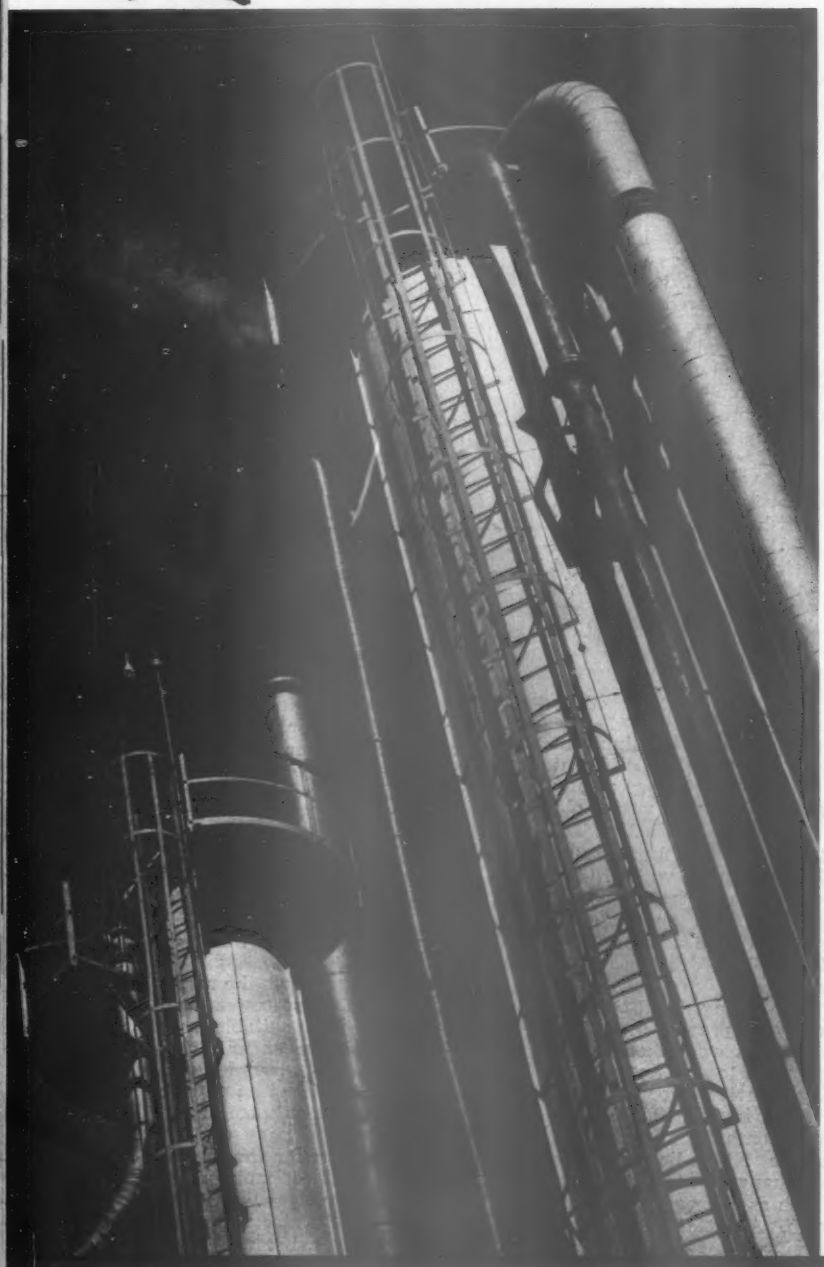

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Chemical Treatment Of Boiler Water

*by John Drew Betz**

"Curealls" for boiler-water treatment are of doubtful value and efficacy. Proper treatment includes several possible steps differing in details and purposes. Fundamentals have been determined for most ailments of boiler waters. Specific prescriptions may be written only after careful study of the individual problem.

THE chemical treatment of boiler water is an important subdivision of the general field of industrial water conditioning. Today, all power-plant operators realize the value of treating boiler water chemically, rather than to suffer the costly consequence of untreated water. It has been proved time and time again that with proper treatment and control, desirable conditions can be maintained economically.

Boiler-water conditioning involves many problems, but the four major objectives are the prevention of scale, corrosion, carryover, and embrittlement. It is with these four major objectives that this article is concerned.

Problems and Causes

Scale: Scale formation on boiler evaporative surfaces is caused principally by the deposition of insoluble calcium and magnesium salts. If a boiler feed water contains appreciable quantities of calcium and magnesium, a hard coating on the heating surfaces of the boiler will result unless steps are taken to precipitate the calcium and magnesium as a fluid sludge. Such scale formation will retard heat transfer and cause a drop in efficiency due to the insulating effect, resulting in a considerable increase in the cost of producing steam. In addition, scale may be the cause of local overheating on the metal resulting in failure, costly repairs, and boiler outage.

*Chemical Engineer, W. H. & L. D. Betz.

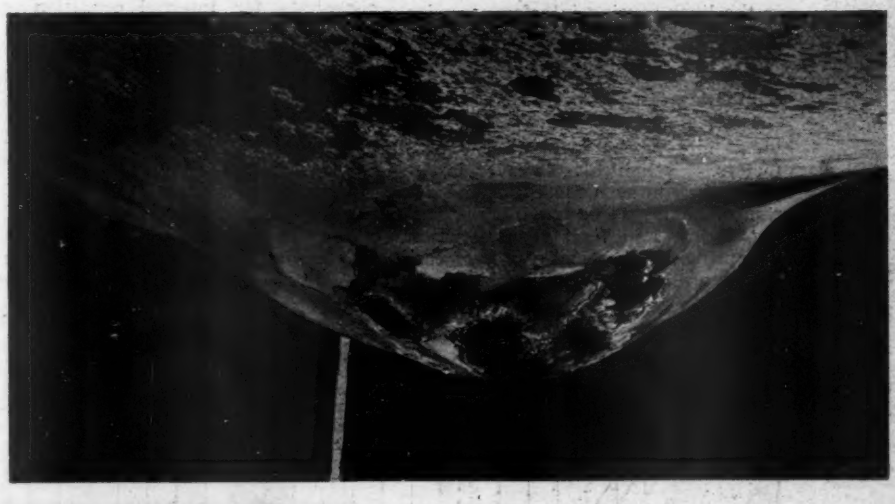
Silica is also responsible for the formation of boiler scale. Fortunately, silica in large quantities is not as common in water as the calcium and magnesium salts. However, where silica is present in appreciable quantities, steps must be taken for its removal or an exceptionally hard, glasslike boiler scale will result.

Finally, the third major cause of boiler scale is the presence of oil. Oil present in the boiler feed water will concentrate in the boiler and will assume a large proportion in a short period of time. Oil acts as a binder, cementing together the suspended solids in the boiler water to form a scale. In addition, carbonization of the oil can take place forming a hard, asphaltic scale.

Oil, however, may cause boiler-tube failures for reasons other than the formation of scale. Oil will gradually accumulate suspended solids in its body and be carried to lower parts of the boiler where the greatest transfer of heat takes place. It is at this point that the resulting damage occurs as this is where the boiler metal is at its highest temperature.

Corrosion: Corrosion of the boiler water may be subdivided into what are commonly called general surface corrosion and pitting. General surface corrosion occurs when the boiler water is relatively acidic in character. Iron and ferrous metals are soluble in an acid solution. Therefore, if the water in the boiler is not sufficiently alkaline, attack of the boiler metal will take place.

Pitting, the second form of corrosion, is caused by the presence of dissolved oxygen. While general surface corrosion will be in evidence through-



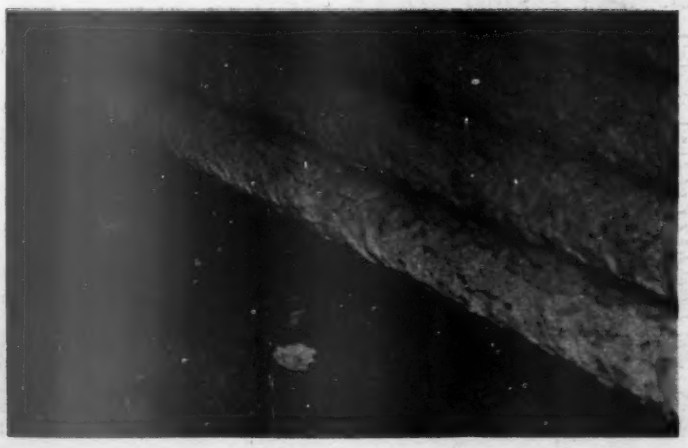


Fig. 1 (Left)—Extensive scale accumulation on the tubes of a 500-hp. Scotch marine motor. Fig. 2 (Above)—Fire sheet of a horizontal tubular boiler, bulged and ruptured as a result of overheating from excessive accumulation of scale

out the entire boiler surfaces, pitting is localized and results in the formation of holes or pits. Any dissolved oxygen present in the boiler feed water is immediately expelled on reaching boiler temperatures and will attack the boiler metal resulting in pits. The formation of these holes or pits is primarily localized to the area adjacent to the feed-water discharge.

General surface corrosion and pitting will greatly shorten the life of the boiler metal, resulting in costly repairs. In some instances of severe pitting, the pit may extend entirely through the tube metal resulting in the formation of a hole, necessitating tube replacement.

Carryover: Carryover is the entrainment of boiler-water solids with the steam. This is undesirable from any viewpoint. When such solids are present, they are usually entrained in solution in moisture carried by the steam. This represents a thermal loss, lowering the temperature of the steam. Solids will deposit on turbine blading causing loss of efficiency and costly shutdowns. Where steam is used to operate engines, the presence of solids will destroy lubrication in the steam cylinder causing scored cylinders and costly repairs. Solids if present in the steam can deposit out in the lines causing interference with the operation of valves and traps. Where live steam is used directly in contact with various processes, contamination can result.

The causes of carryover can be divided into mechanical and chemical factors. Mechanical carryover is dependent upon such factors as the design of boiler, water level, boiler rating, firing, and load characteristics. The principal chemical causes of carryover are high total solids, high suspended solids, high alkalinities, oil, and improper type of external or internal treatment.

High total solids concentrations and/or high suspended solids concentrations resulting from insufficient blowdown are perhaps the chief chemical causes of carryover. However, a carryover condition is aggravated by high alkalinity concentrations if solids are sufficiently high. Care must be exercised in employing phosphate for internal conditioning lest carryover result. Precipitated, finely divided calcium phosphate possesses the property of stabilizing boiler-water foam, frequently resulting in carryover of boiler-water solids with the steam. In order to avoid such conditions, it is sometimes necessary on occasion to resort to excessive blowdown.

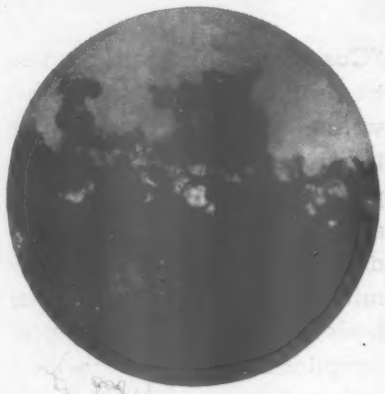


Fig. 4—Photomicrograph of a turbine blade wire drawn by carryover

Embrittlement: Embrittlement or intercrystalline cracking is the fourth major problem confronting the water-treatment engineer. Embrittlement is the chemical failure of the boiler metal. Embrittlement cracks usually occur in drum seams, under rivets, or at rolled-in tube ends. Considerable research has been performed on this subject, and it has been shown that the following conditions must exist simultaneously to cause embrittlement or intercrystalline cracking:

1. It is necessary that leakage be present in a riveted seam or rolled-in tube end that will allow loss of steam and concentration of the boiler water.
2. The boiler metal must be under internal or external strains.
3. The concentrated boiler water must act chemically on the stressed steel. This latter condition presupposes the boiler water to be embrittling in nature.

As can be seen by the foregoing, the problems confronting the water-treatment engineer are numerous and the solutions can rarely be accomplished by the use of one or two chemicals. Each industrial plant presents its own problems and solutions, which can be determined only after an individual and comprehensive plant study. The recommending of one or two materials without an intelligent survey of conditions is sheer folly.

The conditioning of a water for use in a boiler can be divided into two general classes, internal treatment and external treatment. Many people erroneously believe that these two general methods are in opposition to each other. With the exception of a small twilight zone in which the water-treatment engineer should be guided purely by economics, the two classes do not conflict. Based on results and economics, each method of treatment has its own definite application. In many installations the use of internal treatment alone is not advisable, and must be employed jointly with external treatment. Conversely, however, it is rare that external treatment alone can produce a satisfactory condition, and in almost all applications must be supplemented by some internal treatment.

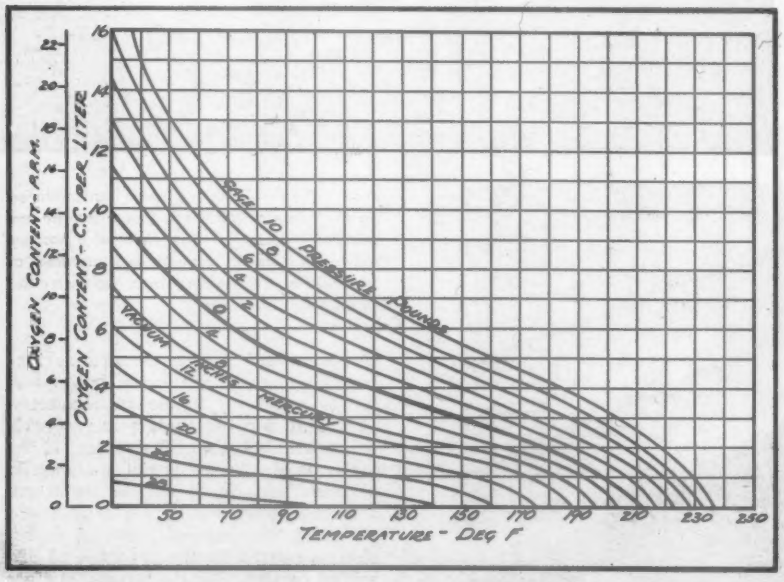


Fig. 3—Solubility of dissolved oxygen in water at various temperatures and pressures

Internal Treatment

Internal treatment of boiler water is by far the most important and most difficult phase of boiler-water conditioning, as it must be employed generally whether or not external treatment is used.

Scale: As previously stated, scale is caused primarily by calcium and magnesium salts, silica, and oil. Each is a separate problem and must be dealt with individually.

For the prevention of calcium and magnesium salts from baking on boiler evaporative surfaces, internal treatment consists of precipitating the calcium and magnesium salts in a favorable form as a sludge, and maintaining this sludge in a fluid form to be

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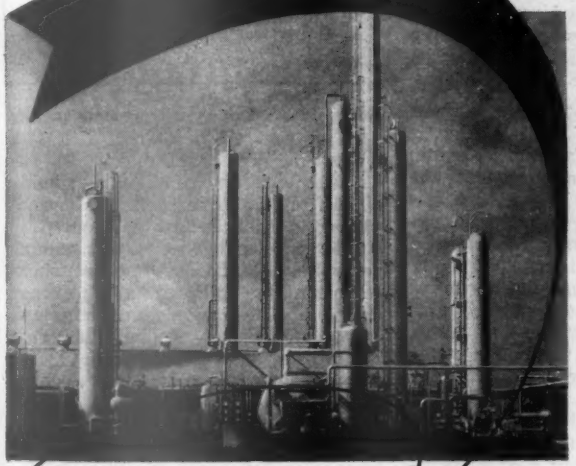

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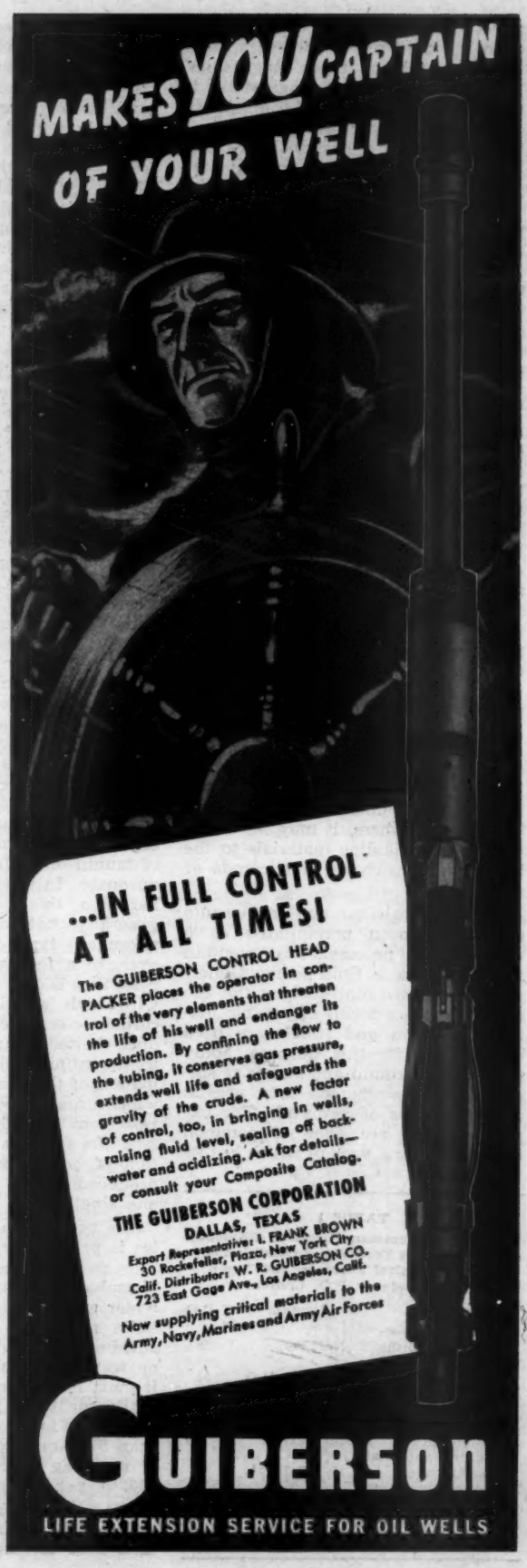
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removed by the boiler blowdown. Calcium is considered to present a more difficult problem than magnesium. This is because the magnesium is readily precipitated by the alkalinity of the boiler water to form a flocculent sludge of magnesium hydroxide.

The most common chemicals employed for the precipitation of the soluble calcium salts are sodium phosphates—trisodium phosphate, disodium phosphate, sodium metaphosphate, and monosodium phosphate. Once any of these phosphates enter the boiler, their action is exactly the same. They are all converted into trisodium phosphate and as such react with the calcium to form tricalcium phosphate, a rather flocculent precipitate. In order for this reaction to take place, sufficient alkalinity must be present in the boiler water. At a pH value of approximately 9.5 or less the calcium is not precipitated properly. The choice of the phosphate to be used depends upon economics and the alkalinity of the boiler water. Acid phosphates such as monosodium phosphate and sodium metaphosphate are used to reduce the alkalinity of the boiler water, whereas trisodium phosphate which is alkaline is used to develop alkalinity in the boiler water. Economically, disodium phosphate is generally the cheapest way to purchase the necessary P_2O_5 content, and in addition, disodium phosphate is a more neutral phosphate. In some instances it is desirable to blend two phosphates to obtain the desired alkalinity. In others, it may be necessary to add alkaline materials to the boiler water such as caustic soda or soda ash.

Once the calcium and magnesium salts have been precipitated as a sludge, it is necessary to maintain this sludge in a fluid form. Generally, this is accomplished by the use of one or more forms of organic material. Tannin and starch are used on occasion for this purpose. Many people view tannin and starch as single materials, whereas they are in reality a class of material. For example, there are over 10 common types of tannins, each of which has its own application and limitations. Some forms of tannins have the drawback of forming calcium tannate, which may cement the calcium phosphate particles together and thus do more harm than good. Sodium mannuronate, a reactive organic colloid, has proved of exceptional value in maintaining a fluid sludge. This organic chemical is precipitated in the boiler by polyvalent ions such as calcium to form a gelatinous floc possessing tremendous adsorptive properties. This floc absorbs in its vast surface and subsurface areas the finely divided inorganic precipitates to form a fluid sludge.

After a fluid sludge of calcium and magnesium precipitates has been formed, it is necessary to remove this sludge from the boilers by blowdown. The amount of blowdown required depends upon the amount of sludge formed and the nature of the sludge. Fluid sludges require less blowdown.

Another type of internal treatment for the prevention of scale is what is commonly known as carbonate-organic treatment. This type treatment has definite uses and limitations. Its principal application is on the so-called self-purging waters—waters in which the alkalinity is approximately equal to or greater than the hardness. This type of treatment employs relatively high concentrations of active organic materials in the boiler water together with the use of sodium carbonate (soda ash) to maintain proper alkalinity concentrations. This active organic is obtained through the use of tannin or preferably sodium mannuronate. In water of low feed-water hardness, this type of treatment is generally not as applicable as a phosphate type of treatment. However, in a feed water of high hardness, that is over 60 to 70 p.p.m., and with high alkalinity concentrations, carbonate-organic treatment can produce better results than phosphate treatment primarily through the elimination of the heavy sludge condition which usually accompanies phosphate treatment of high-hardness feed waters. In some instances, a combination of both types of treatment has produced better results than either one singly.

The prevention of scale due to silica is primarily an external problem. The maintenance of high residual phosphate concentrations in the boiler water are of aid in the prevention of silica scale, but can cope with low silica concentrations only. If the boiler water contains appreciable silica, it must be removed externally. Generally speaking, the silica content of the boiler feed water should be less than 5 p.p.m., especially if the boiler is operating at pressures greater than 450 lb. per sq. in.

The external removal of silica is accomplished in either a hot or cold lime soda-softener, the hot softener possessing greater efficiency for silica removal. The removal of soluble silica from water in the hot is accomplished with the use of magnesium compounds under relatively simple controlled conditions of temperature, retention time, pH, and sludge recirculation. The magnesium compound employed may be epsom salts (magnesium sulfate), dolomitic lime, calcined magnesite, magnesium carbonate, or magnesium oxide. Since magnesium oxide possesses the greatest silica-removal efficiency and does not increase solids content, it is usually employed. The removal of silica in the cold relies upon the use of ferric iron compounds, but this process is not as saticafactory as in the hot.

Oil should always be removed from a boiler feed water externally. There are two principal means of accomplishing this removal: mechanically, by use of a separator, and chemically, by coagulation and filtration. The importance of oil removal prior to its entry into the boiler cannot be overemphasized. In order to minimize the presence of oil in the boiler, oil should

TABLE 1

The Various Common Forms of Phosphate Used in Boiler Feed-Water Conditioning, Their Chemical Formula, and Their Phosphate or P_2O_5 Content

Name—	Formula	% P_2O_5
Monosodium phosphate, anhydrous	NaH_2PO_4	58
Monosodium phosphate, monohydrate	$NaH_2PO_4.H_2O$	51
Disodium phosphate, anhydrous	Na_2HPO_4	48
Disodium phosphate, crystalline	$Na_2HPO_4.12H_2O$	18
Trisodium phosphate, monohydrate	$Na_3PO_4.H_2O$	39
Trisodium phosphate, crystalline	$Na_3PO_4.12H_2O$	18
Sodium metaphosphate, anhydrous	$NaPO_3$	69

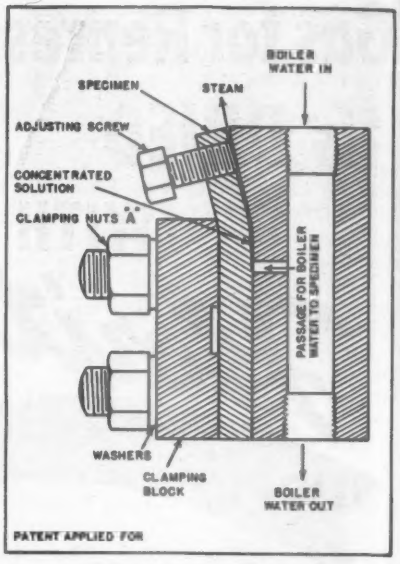

Fig. 5—Diagram of an embrittlement detector

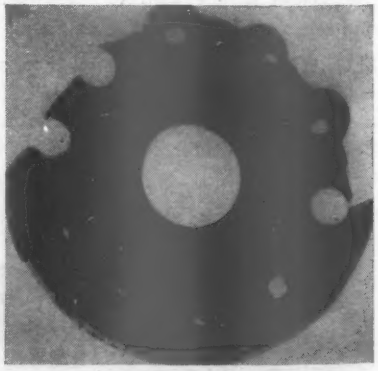

Fig. 6—Embrittlement blowoff flange

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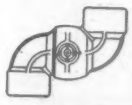

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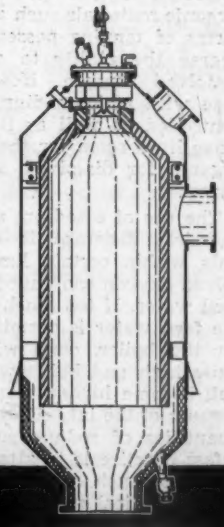

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be employed at a minimum consistent with proper lubrication and should never be employed in excessive amounts.

Corrosion: As previously discussed, corrosion can be divided into two classes: general surface corrosion caused by insufficient alkalinity of the boiler water, and pitting caused by the presence of dissolved oxygen.

The prevention of general surface corrosion is accomplished by elevating the pH value of the boiler water above 10.5. Many times the natural developed alkalinity of the boiler water will provide a sufficient pH value. In other instances, it is necessary to add an alkaline material such as caustic soda or soda ash.

Preventing Boiler-Metal Pitting

Pitting of the boiler metal is prevented by the removal of dissolved oxygen. This may be accomplished internally by use of an oxygen scavenger or externally by use of a deaerating heater. Briefly considering the external method, it is advisable to reduce as much as possible the dissolved oxygen content of the feed water prior to its entrance to the boiler. A properly operated deaerating heater will reduce the dissolved oxygen content to 0.03 cc. per liter. However, if a deaerating heater is not employed, the temperature of the open heater or hot well should be raised close to boiling to eliminate as much dissolved oxygen as possible. In any event, all external methods should be followed by internal oxygen scavengers to remove any residual oxygen.

Sodium sulfite is the most commonly employed oxygen scavenger. This chemical reacts with and removes any dissolved oxygen that it encounters. Organic materials such as the various forms of tannins possess to a small degree the ability to absorb the dissolved oxygen. However, the ease with which sodium sulfite is controlled as well as its economy leave little room for the use of an organic for dissolved oxygen removal.

The use of a sodium sulfite as a chemical deaerant is economical only within certain limits of dissolved oxygen content of the boiler feed water. If too much oxygen in the feed water is permitted to enter the boiler, costs will become quite high and boiler-water solids will become higher than desirable because of the introduction of large quantities of sodium sulfite. The safest practice is to attempt to remove as much oxygen as possible by mechanical means through the use of efficient types of feed water heaters and to maintain a residual of sodium sulfite in the boiler water to take care of any oxygen which has not been removed by mechanical means.

Carryover: Carryover due to mechanical reasons cannot be chemically corrected by the water-treatment engineer. However, carryover which is due to the chemical characteristics of the boiler water is a problem of water conditioning. High total solids and/or high suspended solids in the boiler water resulting from a low rate of blowdown are frequently the chief chemical characteristics that cause a carryover condition.

The question, "How high can boiler-water solids be carried before encountering difficulty with carryover?" is often asked of the water-treatment engineer. The true answer can be obtained only after a steam study of a particular plant. This fact is because all boilers operate differently, depending on the design of the boiler, the type of internal treatment used, the characteristics of the solids, the pressure of operation, and load characteristics. The American Boiler Manufacturer's Association in attempting to generalize has set up the following standards for total solids content of the boiler water to meet the standard guarantee of steam purity:

Gage pressure—	P.p.m.
Up to 300-lb. gage	3,500
301 to 450-lb. gage	3,000
451 to 600-lb. gage	2,500
701 to 900-lb. gage	1,500
901 to 1,000-lb. gage	1,205
1,001 to 1,500-lb. gage	1,000

In order to prevent the entrainment of boiler-water solids with the steam, it is necessary that the chemical causes be eliminated. Solids should be controlled by blowdown and high alkalinities should not be permitted to develop. One other important step can be taken to eliminate carryover. With the use of certain chemicals it is possible to prevent foam stabilization until very high total solids have been developed. Sodium mannuronate, which is a reactive organic colloid, has proved of exceptional value in its field. In some instances it is possible to carry more than twice the solids concentrations with the use of sodium mannuronate before carryover is experienced. Thus, the need of excessive blowdown is eliminated.

Fig. 7—Ruptured tube from a 1,400-lb. per sq. in. water-tube boiler

Oil-Caused Trouble

Oil in the boiler water even in small quantities will cause a carryover condition and should be eliminated as discussed under the prevention of scale. A small amount of oil can lead to considerable trouble. The American Boiler Manufacturer's Association will not guarantee a boiler's steam purity when oil is present in the boiler in quantities greater than 7 p.p.m. This in itself speaks for the importance of the elimination of oil in the feed water.

Embrittlement: In order that intercrystalline cracking of the boiler metal to occur, the simultaneous conditions of leakage, stress, and concentration must exist. However, in addition the boiler water must be embrittling in nature. The prevention of intercrystalline cracking depends upon rendering a boiler water non-embrittling.

Previous methods for the prevention of embrittlement depended upon maintaining a certain sulfate-carbonate ratio in the boiler water. This ratio was determined by dividing the sodium sulfate content of the boiler water by the sodium carbonate content. The American Society of Mechanical Engineers suggested the following ratio be maintained:

Up to 150-lb. gage	A ratio of 1
150 to 250-lb. gage	A ratio of 2
Above 250-lb. gage	A ratio of 3

If the ratio obtained from the boiler-water analysis is equal to or higher than that shown above, it was thought that the water should not cause intercrystalline cracking. If a lower ratio was obtained, it was necessary to feed sodium sulfate or sodium acid sulfate to the boiler in order to raise the ratio.

The A.S.M.E. sulfate-carbonate ratios were created to fill a gap. Research performed within the last 5 years has largely antedated their use. The water-treatment engineer now has available two tools for the prevention of embrittlement: the embrittlement detector as developed by the joint research committee, and the Straub test as developed by Prof. F. G. Straub, of University of Illinois. Both of these methods will determine if a water has embrittling characteristics and if so, steps can be taken to eliminate these characteristics. The chemicals employed for the prevention of embrittlement are sodium nitrate, quebracho tannin,

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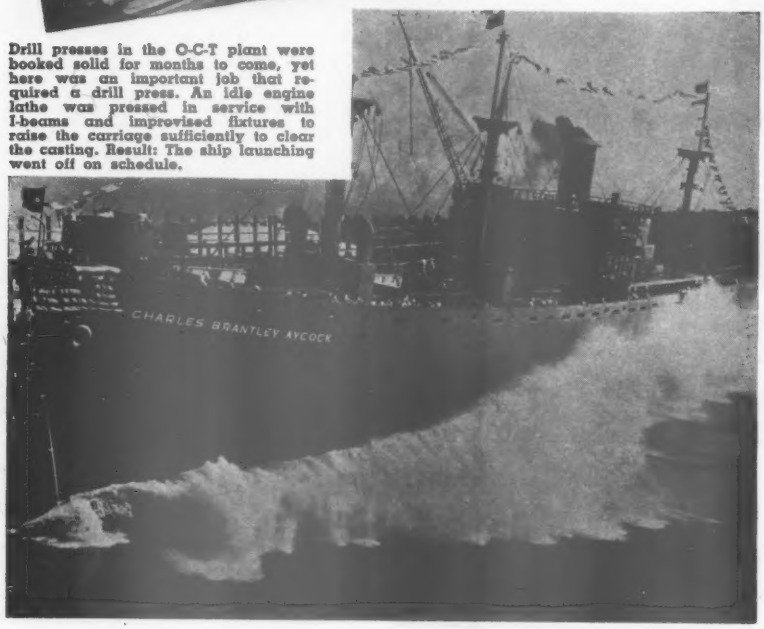

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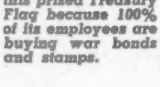

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and waste sulfite liquor. It is impossible to predict which of these chemicals will prove satisfactory and each must be tried one after the other until one is found that will render the water nonembrittling. Sodium nitrate is always the first chemical to be tried, and in the great majority of cases will prove satisfactory. Quebracho tannin, which is usually tried second, discolors the boiler water making routine control analyses difficult. Waste sulfite liquor has been used only in railroad practice. This chemical promotes a foaming condition and is not employed for stationary work. Another method for the prevention of embrittlement is the coordinated pH-phosphate control. Although this method provides a satisfactory answer to the problem, its use is generally restricted to plants which employ evaporated makeup water.

External treatment or pretreatment has clearly defined objectives. These are to deliver a clarified and softened water to the boiler. A raw water is clarified by such means as sedimentation, coagulation, and filtration, and these steps are always desirable when the raw water supply contains turbidity or sedimentation. External softening has more limited use based upon economics and chemical characteristics of the water. The first point to determine is whether external softening is required, and the second point is the choice of softener to be employed. In this choice the water-treatment engineer has available hot and cold lime soda softeners, hot phosphate softeners, sodium zeolite softeners, hydrogen zeolite softeners, and anion exchangers. It is not within the scope of this article to go into this phase, but a warning can be given. Many industrial plants have purchased unnecessary or incorrect-type softeners. Be sure that a detailed plant study is made so as to determine if and what type water softener is required. A plant is then in the position to procure competitive bids on the proper softener.

Conclusion

The purpose of this article has been to briefly present the more common boiler-water problems confronting the water-treatment engineer, together with the methods and chemicals he employs for their proper solution. Boiler-water treatment has progressed rapidly in the last 20 years and has become a definite science. The use of a "cureall," whether a chemical or a mechanical device, is highly questionable in light of the present scientific knowledge of water conditions. Proper boiler-water treatment includes not only the use of chemicals for the prevention of scale, corrosion, carryover and embrittlement, but also intelligent supervision and control.

REFINERIES OPERATING IN UNITED STATES

Explanation of Terms in Survey

Cracking capacity is based on daily capacity to produce cracked gasoline. In a few cases companies reported raw-charging capacity.

(Comp.)—Complete plant, gasoline, kerosene, gas oil, fuel oil, lubricating oils, paraffin, wax, and asphalt, usually includes cracking.

(S)—Gasoline, kerosene distillate, gas oil, and fuel oil.

(L)—Lubricating oils.

(A)—Asphalt.

(C)—Same products as skimming, except plants are equipped for cracking.

(W)—Wax.

(Capacities in barrels daily)

ALABAMA

Company and plant location—	Crude oil cap. bbl.	Cracked gaso. cap. bbl.	Type of refinery
Coastal Pet. Corp., Mobile	4,000	.....	S

ARKANSAS

Berry Asphalt Co., Waterloo	1,500	.....	S-L-A
Cross Co., Henry H., Smackover	6,000	.....	S-L-A
Lion Oil Ref. Co., El Dorado	19,000	2,000	S-C-L-A
Macmillan Pet. Corp., Norphlet	4,000	.....	S-L-A
Root Pet. Co., El Dorado	12,000	3,000	S-C
Stephens Ref. Co., Inc., Stephens	1,500	.....	S
Total	44,000	.....	

CALIFORIA

Bell Oil & Ref. Co., Santa Maria	2,500	.....	S-A
Caminol Co., Ltd., Santa Fe Springs	4,000	600	S-C
Caminol Co., Ltd., Hanford	3,500	1,000	S-C
Century Oil Co., Signal Hill	5,000	.....	S
Comet Oil Co., Ltd., Long Beach	2,500	750	S-C
Eagle Oil & Ref. Co., Santa Fe Springs	5,500	450	S-C
Elm Oil Co., Long Beach	2,500	.....	S
El Tejon Oil & Ref. Corp., Mountain View	3,500	425	S-C
Envoy Pet. Co., Los Angeles	3,500	.....	S-A
Exeter Ref. Co., Long Beach	10,000	.....	S-A
Field, O. C., Gasoline Corp., Casmalia	4,000	.....	S-A
Five C Ref. Co., Santa Maria	2,500	.....	S-A
Fletcher Oil Co., Inc., Wilmington	3,100	1,700	S-C
General Pet. Corp. of Calif., Torrance	65,000	2,600	S-C
General Pet. Corp. of Calif., Lebec	23,000	3,400	S
Gilmore Oil Co., Vernon	2,500	.....	S-A
Golden Bear Oil Co., Oildale	2,500	.....	S-L-A
Hancock Oil Co. of Calif., Long Beach	12,000	1,250	S-C
Krieger Oil Co. of Calif., Clearwater	3,000	.....	S-A
Los Nitos Prod. & Pet. Co., Kettleman Hills	1,500	.....	S
McCallen Ref. Co., Huntington Beach	4,000	.....	S-A
Macmillan Pet. Corp., Long Beach	7,500	.....	S
Mohawk Pet. Co., Bakersfield	7,000	1,700	S-C
Newhall Ref. Co., Newhall	2,000	.....	A
Norwalk Co., Maricopa	4,000	.....	S
Operators Oil & Ref. Co., Long Beach	2,000	.....	S
Pacific Central Ref. Co., Santa Maria	1,500	.....	S-A
Pacific States Oil Co., Wilmington	7,000	600	S-C
Palomar Ref. Co., Bakersfield	1,500	.....	S-L-A
Paraffine Cos., Inc., Emeryville	1,400	.....	S-A
Pathfinder Pet. Co., Long Beach	3,500	.....	S
Petrol Corp., Los Angeles	6,500	.....	S-A
Richfield Oil Corp., Watson	80,000	13,000	Comp.
Rothschild Oil Co., Santa Fe Springs	6,000	1,400	S-C
Seaside Oil Co., Ventura	4,000	.....	S-A
Shell Oil Co., Inc., Martinez	29,700	7,200	S-C-L-A
Shell Oil Co., Inc., Oil Fields	6,700	.....	S
Shell Oil Co., Inc., Wilmington	44,000	12,300	S-C
Socal Oil & Ref. Co., Huntington Beach	6,650	1,350	S-C
Standard Oil Co. of Calif., El Segundo	100,000	9,500	S-C-L-A
Standard Oil Co. of Calif., Richmond	100,000	11,500	S-C-L-A
Standard Oil Co. of Calif., Seguro	25,000	.....	S-A
Texas Co. of Calif., Los Angeles	36,000	4,700	S-C
Texas Co. of Calif., Fillmore	4,000	1,000	S-C
Tide Water Associated Oil Co., Avon	43,600	8,000	S-C-L-A
Tide Water Associated Oil Co., Watson	14,000	400	S-C
Tiernan Ref. Co., Long Beach	1,500	.....	S-A
Triangle Oil & Ref. Co., Playa Del Rey	1,000	.....	S
Union Oil Co., Wilmington	47,500	6,000	S-C-A
Union Oil Co., Maltha (Bakersfield)	8,000	.....	S-A
Union Oil Co., Oleum	34,000	5,800	Comp.
Wilshire Oil Co., Inc., Norwalk	16,000	5,500	S-C
Total	812,150	.....	

COLORADO

Company and plant location—	Crude oil cap. bbl.	Cracked gaso. cap. bbl.	Type of refinery
Bay Pet. Corp., Denver	4,000	1,800	S-C
Continental Oil Co., Denver	2,700	1,500	S-C
Oriental Ref. Co., Alamosa	1,000	1,000	S-C
Oriental Ref. Co., Denver	2,000	.....	S
Perry Pet. Co., Denver	1,000	.....	S
Raven Oil & Ref. Co., Rangely	125	.....	S
Texas Co., Craig	3,000	1,500	S-C
Total	13,825	.....	

DELAWARE

Texas Co., Claymont	3,500	.....	S-A

GEORGIA

Mexican Pet. Corp. of Georgia, Savannah	4,000	.....	S-A

IDAHO

Gem State Ref. Co., Twin Falls	300	.....	S
Idaho Ref. Co., Pocatello	2,200	1,500	S-C-A
Total	2,500	.....	

ILLINOIS

Advance Ref. Co., Inc., Centralia	3,250	.....	S
Allied Oil Corp. of Illinois, St. Elmo	4,000	600	S-C
Arrow Pet. Co., Centralia	3,500	.....	S
Calumet Ref. Co., Burnham	1,200	.....	S-C-L
Cascade Ref. Co., Salem	3,000	600	S-C
Cross, Henry H. Co., Colmar	1,000	.....	S
Cross, Henry H. Co., Dupo	1,000	.....	S
Globe Oil & Ref. Co. (Ill.), Lemont	27,000	5,500	S-C
Indian Ref. Co., Lawrenceville	33,000	8,700	S-C-L-A
Milan Ref. Co., Milan	3,000	.....	S
Ohio Oil Co., Robinson	15,000	4,500	S-C-A
Pana Ref. Co., Pana	4,000	1,650	S-C
Shell Oil Co., Inc., Wood River	75,000	29,000	S-C-L-A
Socony-Vacuum Oil Co., Inc., E. St. Louis	16,000	4,800	S-C
Standard Oil Co. (Ind.), Wood River	26,000	6,400	S-C-L-A
Texas Co., Lockport	50,000	15,500	S-C-L-A
Transport Oil & Ref. Co., Dupo	2,500	.....	S-A
Wireback, B. F., Colmar	500	.....	S
Wood River Oil & Ref. Co., Inc., Hartford	12,000	3,000	S-C
Worth Ref. Co., Blue Island	6,000	2,000	S-C
Total	286,950	.....	

INDIANA

Cities Service Oil Co. (Del.), E. Chicago	30,000	11,000	S-C
Evansville Ref. Co., Evansville	2,500	.....	S
Indiana Farm Bureau Co-Op. Assn., Inc., Mount Vernon	3,200	.....	S
Johnson Oil Supply, Gary	1,500	.....	S
Rock Island Ref. Corp., Rock Island	6,000	2,200	S-C
Sinclair Ref. Co., East Chicago	55,000	13,000	S-C-L-W
Socony-Vacuum Oil Co., Inc., E. Chicago	25,000	5,000	S-C
Standard Oil Co. (Ind.), Whiting	119,000	47,700	Comp.
Troy Ref. Corp., Troy	900	.....	S-A
Total	243,100	.....	

KANSAS

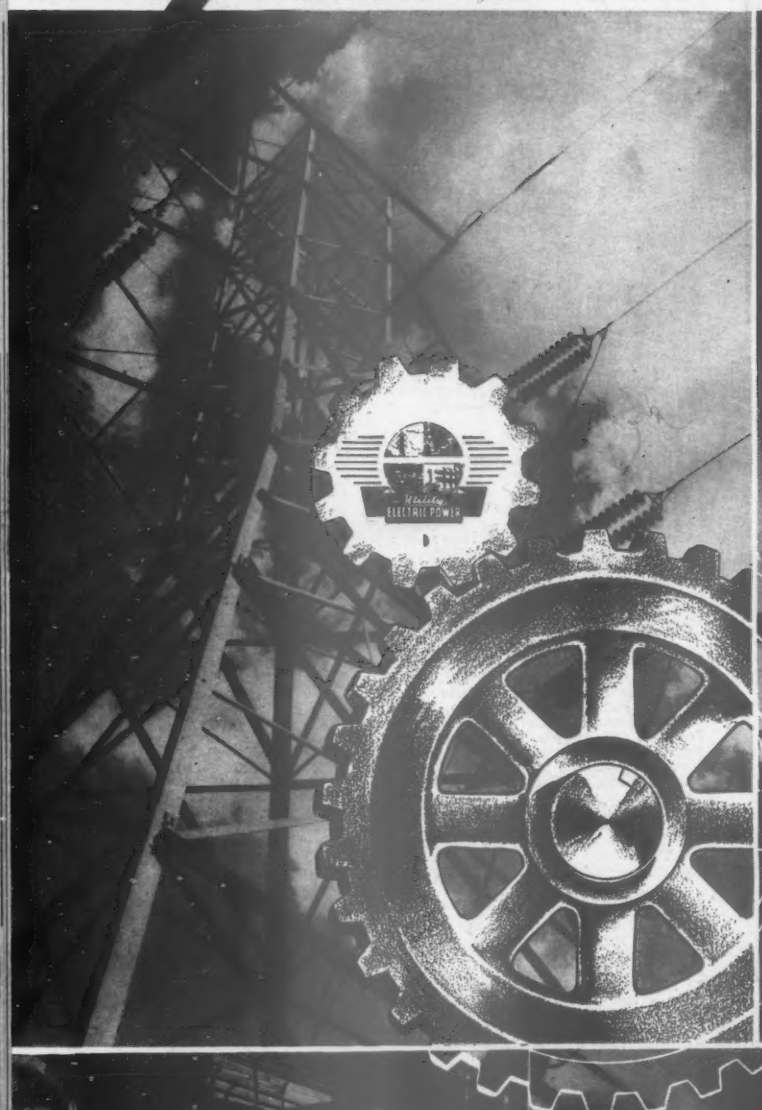
Anco Ref. Co., Inc., Garnett	500	.....	S
Bareco Oil Co., Wichita	6,000	1,500	S-C
Bay Pet. Corp., McPherson	5,000	2,500	S-C
Chanute Ref. Co., Chanute	1,000	1,000	S-C
Cooperative Ref. Assoc., Phillipsburg	3,500	640	S-C
Derby Oil Co., Wichita	8,000	1,500	S-C-A
El Dorado Ref. Co., El Dorado	8,000	3,500	S-C
Falcon Ref. Co., Great Bend	2,000	.....	S
Globe Oil & Ref. Co., McPherson	15,000	4,450	S-C-L
H. & T. Refinery, Chase	2,000	.....	S
Kanotex Ref. Co., Arkansas City	12,000	7,500	S-C-A
National Ref. Co., Coffeyville	9,500	2,500	S-C-L-W
Petroleum Products, Chanute	2,000	.....	S-C
Phillips Pet. Co., Kansas City	27,000	12,000	S-C
Shallow Water Ref. Co., Shallow Water	2,500	175	S-C-A
Sinclair Ref. Co., Coffeyville	11,000	2,700	S-C-L-W
Sinclair Ref. Co., Kansas City	12,000	3,700	S-C
Skelly Oil Co., El Dorado	25,000	9,000	S-C-A
Socony-Vacuum Oil Co., Augusta	22,500	10,000	S-C-A
Standard Oil Co. (Ind.), Neodesha	7,700	2,640	S-C
Vickers Pet. Co., Potwin	5,500	1,600	S-C
Workman Oil & Ref. Co., McCune	100	.....	S
Total	187,800	.....	

KENTUCKY

Aetna Oil Co., Louisville	8,000	1,000	S-C
Ashland Oil & Ref. Co., Catlettsburg	20,000	4,200	S-C-L-A
Greenville Ref. Co., Inc., Greenville	50	.....	S
Latonia Oil Corp. (Standard Oil of Ohio), Covington	14,000	5,300	S-C-A
Louisville Ref. Co., Inc., Louisville	7,000	2,500	S-C
South Ky. Pipe Line Co., Somerset	400	.....	S
Stoll Oil Ref. Co., Louisville	2,000	.....	S-L-W
Texas Co., Pryse	5,000	2,000	S-C
Tri-State Refineries, Inc., Spottsville	1,000	.....	S
Total	57,450	.....	

Geared to the

CONSTANT IMPROVEMENT IN REFINING METHODS SUPPORTED

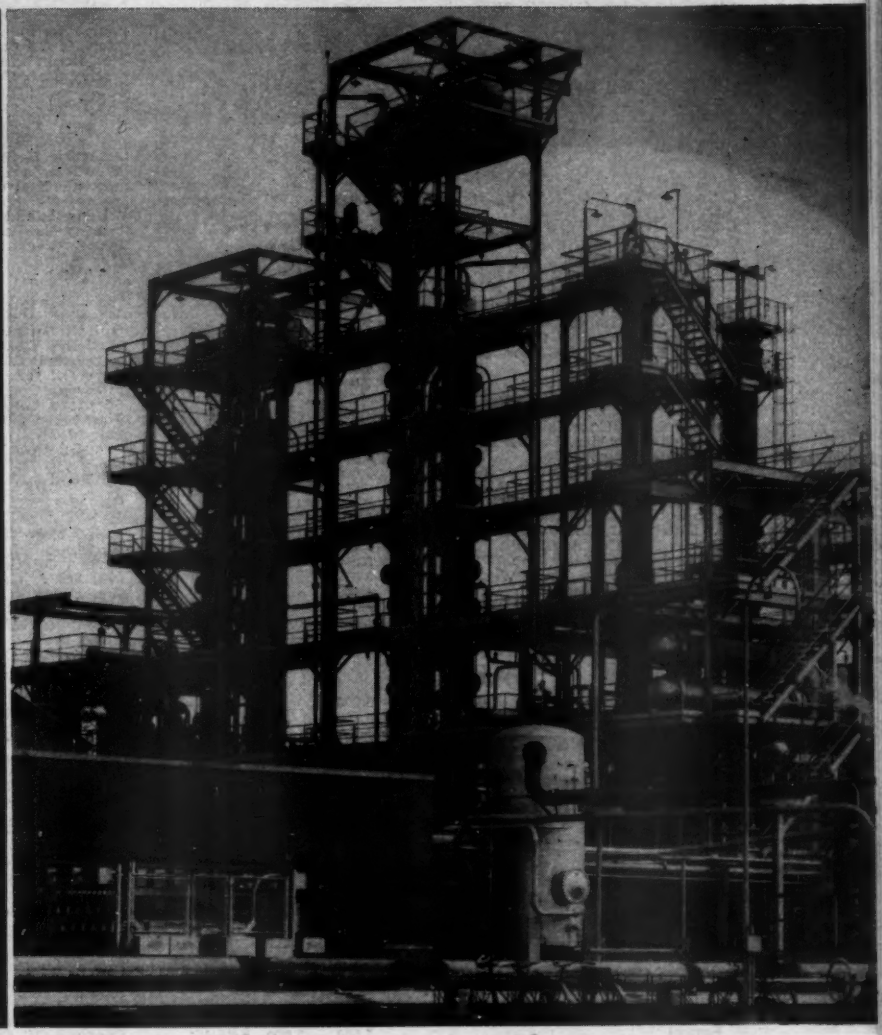


SAFEGUARD YOUR MOTORS!

- Establish a dated maintenance schedule.
- Check clearance, bearings, contact fingers, control equipment, and oil distribution transformer.
- Check air gap and varnish coils.
- Keep worn out parts for exchange on new purchases.

tempo of each new day

BY EXTREME FLEXIBILITY OF *UTILITY ELECTRIC POWER* . . .



The remarkable advancement in the field of refining is one of the amazing achievements of the day. High-quality aviation-fuel ingredients, high octane gasolines, Butadiene for synthetic rubber, and many other developments directly vital to Victory can be attributed to refining progress. In other words, the refining industry has made itself *flexible*. It is geared to the tempo of each new day. Likewise, Utility Electric Power is also extremely *flexible*. It is designed to meet the ever changing need for power, wherever and whenever that need arises. Yes, *Utility Electric Power* has gone to war "behind the lines." . . .

It's *Dynamite* to Our Enemies!

Use Utility Electric Power!

PETROLEUM ELECTRIC POWER ASSOCIATION

LOUISIANA

Company and plant location—	Crude oil cap. bbl.	Cracked gaso. cap. bbl.	Type of refinery
Arkansas Fuel Oil Co., Bossier City	27,000	8,350	S-C
Atlas Oil & Ref. Co., Shreveport	12,000	6,000	S-C
Bayou State Oil Corp., Hosston	800	.....	S-L-A
Chalmette Pet. Corp., Chalmette	8,000	2,500	S-C
Continental Oil Co., West Lake	8,000	4,000	S-C
Evangeline Ref. Co., Jennings	1,000	.....	S-L
Evansville Oil Corp., Cotton Valley	2,500	.....	S
General Oil Corp., Meraux	5,000	.....	S
Pan American Pet. Corp., Destrehan	7,500	.....	S-A
Premier Oil Ref. Co. of Tex., Cotton Valley	6,000	.....	S
Princeton Ref. Corp., Princeton	600	.....	S-L-A
Shell Oil Co., Inc., Norco	21,000	6,200	S-C-A
Standard Oil Co. of La., Baton Rouge	120,000	22,550	Comp.
Stanolind Oil & Gas Co., Vivian	3,300	1,200	S-C
Total	222,700	.....	

MARYLAND

Continental Oil Co., Baltimore	7,500	3,500	S-C-A
Pan American Ref. Corp., Baltimore	8,000	.....	S-A
Standard Oil Co. of N. J., Baltimore	27,000	5,300	S-C-L-A
Total	42,500	.....	

MASSACHUSETTS

Cities Service Oil Co. (Pa.), E. Braintree	20,000	7,700	Comp.
Colonial Beacon Oil Co., Everett	34,860	7,650	S-C-A
Total	54,860	.....	

MICHIGAN

Aurora Gasoline Co., Detroit	6,000	2,500	S-C
Aurora Gasoline Co., Elsie	3,000	.....	S
Bay Ref. Corp., Bay City	4,400	.....	S
Crystal Ref. Co. of Carson City, Inc., Carson City	6,000	.....	S
Essex Ref. Co., Bay City	2,000	.....	S
Fort Dale Oil & Ref. Co., Bloomingdale	1,500	.....	S
Lakeside Ref. Co., Kalamazoo	1,700	.....	S
Leonard Refineries, Inc., Alma	3,000	750	S-C
Leonard Refineries, Inc., St. Louis	4,000	1,100	S-C
Marvel Ref. Co., Grand Rapids	2,000	.....	S
Mid-West Refineries, Inc., Alma	4,000	1,600	S-C
Mid-West Refineries, Inc., Grandville	5,500	1,800	S-C
Naph-Sol Ref. Co., Muskegon	5,000	2,500	S-C
Old Dutch Ref. Co., Muskegon	4,000	1,300	S-C
Peerless Ref. Co., Saginaw	700	.....	S
Petroleum Specialties, Inc., Flat Rock	3,000	750	S-C
Producers Ref. Co., Inc., West Branch	3,500	.....	S-A-W
Pure Oil Co., Midland	4,200	.....	S
Roosevelt Oil Co., Mount Pleasant	5,500	750	S-C
Socony-Vacuum Oil Co., Trenton	25,000	10,000	S-C
Total	94,000	.....	

MINNESOTA

Northwestern Ref. Co., St. Paul Park	3,000	.....	S
Purzone, Inc., Minneapolis	4,500	.....	S
Total	7,500		

MISSISSIPPI

Johnston, E. C., Vicksburg	4,000	.....	S
Paluxy Asphalt Co., Crupe	3,000	.....	S
Total	7,000		

MISSOURI

Joplin Ref. Co., Joplin	500	.....	S
Standard Oil Co. (Ind.), Sugar Creek	24,600	6,820	S-C-A
Total	25,100	.....	

MONTANA*

Big Lake Oil Co., Lake Basin	80	.....	S
Big West Oil Co. of Montana, Kevin	1,500	1,000	S-C
Continental Oil Co., Lewistown	1,225	.....	S
Farmers Union Central Exchange, Inc., Laurel	5,500	3,000	S-C-A
Glacier Prod. Co., Cut Bank	4,500	2,400	S-C
Hart Refineries, Missoula	550	100	S-C
Hole Bros. Refinery, Cut Bank	350	.....	S
Home Oil & Ref. Co., Great Falls	2,500	1,000	S-C-A
Hunt, Eugene, Winnett	400	.....	S
Northwest Ref. Co., Cut Bank	4,500	1,000	S-C
Petroleum Ref. Corp., Shelby	1,000	.....	S
Texas Co. (International Ref. Co.), Sunburst	7,500	2,500	S-C
Yale Oil Corp., Billings	8,000	.....	S-L-A
Total	37,605	.....	

*Some of the small skimming plants operate part time.

NEBRASKA

Carpenter, Terry, Inc., Scottsbluff	1,200	600	S-C
Cooperative Refinery Assn., Scottsbluff	1,350	160	S-C
Gordon Ref. Co., Gordon	100	.....	S
Mid-States Ref. Co., Falls City	3,000	.....	S
Nebraska Prod. & Ref. Co., Salem	2,000	.....	S
Petroleum Utilities Co., Inc., Chadron	700	.....	S
Porter Oil Co., Sidney	300	.....	S
Searle Pet. Co., Omaha	1,000	.....	S
Total	9,650	.....	

NEW JERSEY

Company and plant location—	Crude oil cap. bbl.	Cracked gaso. cap. bbl.	Type of refinery
Cities Service Oil Co. (Pa.), (Petty Island), Camden	20,000	4,500	S-C
Cities Service Oil Co. (Pa.), Linden	12,000	.....	S-A
Socony-Vacuum Oil Co., Paulsboro	25,200	8,000	Comp.
Standard Oil Co. of N. J., New Jersey Works (Bayonne, Linden, N. J.)	124,000	25,800	Comp.
Tide Water Associated Oil Co., Bayonne	57,000	8,300	S-C-L-W
Total	238,200	.....	

NEW MEXICO

Aerex Co., Bloomfield	100	.....	S
Basin Ref. Co., Aztec	100	.....	S
Continental Oil Co., Artesia	1,500	640	S-C
Continental Oil Co., Farmington	750	.....	S
Malco Refineries, Inc., Artesia	3,000	550	S-C
McNutt Oil & Ref. Co., Brickland	1,400	300	S-C
Petroleum Products Ref. Co., Prewitt	1,500	.....	S
Valley Ref. Co., Roswell	1,200	300	S-C-A
Total	9,550	.....	

NEW YORK

Allegany Refiners, Inc., Bolivar	2,500	.....	S-L-W
Frontier Fuel Oil Corp., Tonawanda	7,000	2,000	S-C
Sinclair Ref. Co., Wellsville	9,000	2,500	S-C-L-W
Socony-Vacuum Oil Co., Brooklyn and Long Island City	19,000	5,200	Comp.
Socony-Vacuum Oil Co., Buffalo	16,000	7,200	Comp.
Socony-Vacuum Oil Co., Olean	6,500	.....	S-L
Total	60,000	.....	

OHIO

Gulf Ref. Co., Cleves	26,600	14,000	S-C-A
Gulf Ref. Co., Toledo	21,200	10,000	S-C
National Ref. Co., Findlay	9,300	2,300	Comp.
Pure Oil Co., Newark	15,500	5,700	S-C
Pure Oil Co., Toledo	29,400	9,700	S-C
Standard Oil Co. (Ohio), Cleveland	28,000	9,700	Comp.
Standard Oil Co. (Ohio), Lima	10,500	4,000	S-C
Standard Oil Co. (Ohio), Toledo	20,000	7,200	S-C-L-W
Sun Oil Co., Toledo	30,000	12,000	S-C
Total	190,500	.....	

OKLAHOMA

Allied Materials Corp., Stroud	1,500	.....	S-L-A
Anderson-Prichard Ref. Corp., Cyril	8,000	3,000	S-C-A
Bareco Oil Co., Barnsdall	5,000	1,500	S-C-L-W
Bell Oil & Gas Co., Granfield	5,000	1,250	S-C
Ben Franklin Ref. Co., Ardmore	4,500	1,300	S-C-A
Black Gold Ref. Co., Oklahoma City	2,000	1,000	S-C
Champlin Ref. Co., Enid	16,000	4,000	S-C-L-W
Cities Service Oil Co. (Del.), Ponca City	11,000	2,500	Comp.
Continental Oil Co., Ponca City	26,000	14,500	S-C-L-W
Cosco Oil Co., Wynnewood	3,000	575	S-C-A
Cushing Ref. & Gaso. Co., Cushing	5,000	800	S-C
Deep Rock Oil Corp., Cushing	10,500	2,500	Comp.
Johnson Oil Ref. Co., Cleveland	5,500	1,500	S-C
Mercury Oil Ref. Co., Oklahoma City	2,000	1,200	S-C
Mid-Continent Pet. Corp., West Tulsa	40,000	8,000	Comp.
Monarch Refineries, Inc., Oklahoma City	1,000	.....	S-A
Peppers Gasoline Co., Oklahoma City	500	.....	S
Phillips Pet. Co., Okmulgee	7,000	1,500	S-C-L
Rock Island Ref. Co., Beckett	7,500	2,500	S-C-A
Shale Oil Co., Lawton	80	.....	S
Sinclair Ref. Co., Sand Springs	4,500	900	S-C-L-W
Sunray Oil Co., Allen	8,750	2,700	S-C
Texas Co., West Tulsa	22,000	6,000	S-C-L
Tide Water Associated Oil Co., Drumright	12,000	2,300	S-C
Wilcox, H. F., Oil & Gas Co., Bristow	5,000	2,000	S-C
Total	213,330	.....	

PENNSYLVANIA

Atlantic Ref. Co., Philadelphia	95,000	25,700	Comp.
Berry, James B., Sons Co., Inc.	2,500	1,200	S-C-L-W
Bradford Penn Ref. Corp., Clarendon	1,500	.....	S-L-W-A
Canfield Oil Co., Coraopolis	1,500	.....	S-L
Cities Service Oil Co. (Pa.), Titusville	3,000	.....	S-L-W
Conewango Ref. Co., Warren	.....	.....	L
Continental Ref. Co., Oil City	1,000	8,400	S-C-L-W
Daugherty Ref., Petrolia	4,000	.....	S-L
Franklin Creek Ref. Corp., Franklin	2,000	.....	S-L-W
Freedom Oil Co., Freedom	3,300	600	S-C-L-W
Gulf Oil Corp., Philadelphia	58,000	25,000	S-C-L
Gulf Oil Corp., Pittsburgh	12,400	6,000	S-C-L
Kendall Ref. Co., Bradford	5,000	2,200	S-C-L-W
Penna. Oil Prod. Ref. Co., Eldred	3,000	500	Comp.
Pennsylvania Ref. Co., Karns City	2,000	.....	S-L-W
Pennsylvania Ref. Co., Titusville	2,000	.....	S-L-W
Pennzoil Co., Rouseville	8,500	5,500	S-L-W
Quaker State Oil Ref. Corp., Emlenton	2,000	1,200	S-C-L-W
Quaker State Oil Ref. Corp., Bradford	4,000	1,500	S-C-L-W
Sherwood Ref. Co., Warren	800	.....	S
Sinclair Ref. Co., Marcus Hook	55,000	15,000	S-C
Sun Oil Co., Marcus Hook	90,000	36,000	Comp.
Superior Oil Works, Warren	500	.....	S-L-W
Ultra-Penn Ref. Co., Bruin†	.....	.....	
United Ref. Co., Warren	5,500	1,760	S-C-L-W
Valvoline Oil Co., Butler	2,500	.....	S-L-W
Waverly Oil Works Co., Pittsburgh	2,500	.....	S-L-W
Wolf's Head Oil Ref. Co., Inc., Reno	2,000	.....	S-C-L-W
Total	369,500	.....	

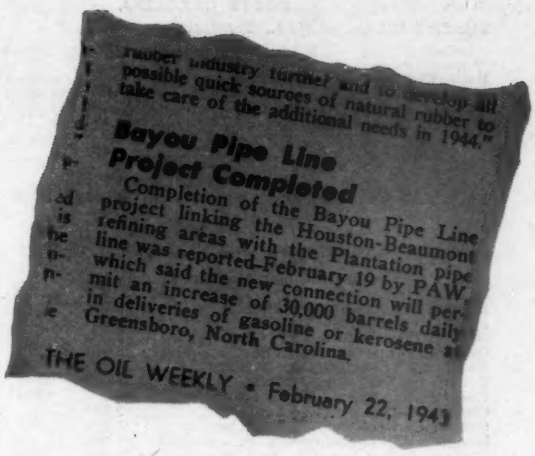
NEVER TOO LITTLE
NEVER TOO LATE

Again, GULF STATES Delivers On Time!

The Bayou Pipe Line System from Baytown to Baton Rouge is using electric power throughout for its pumping requirements. Nine of the eleven pump stations are served direct by Gulf States Utilities Company and another is served indirectly.

This system, which ties in with the Plantation Pipe Line System at Baton Rouge, connects the refinery areas of the Houston and Sabine districts to the Eastern seaboard. The Plantation Pipe Line now extends from Baton Rouge, Louisiana to Greensboro, North Carolina and will be extended to Richmond, Virginia.

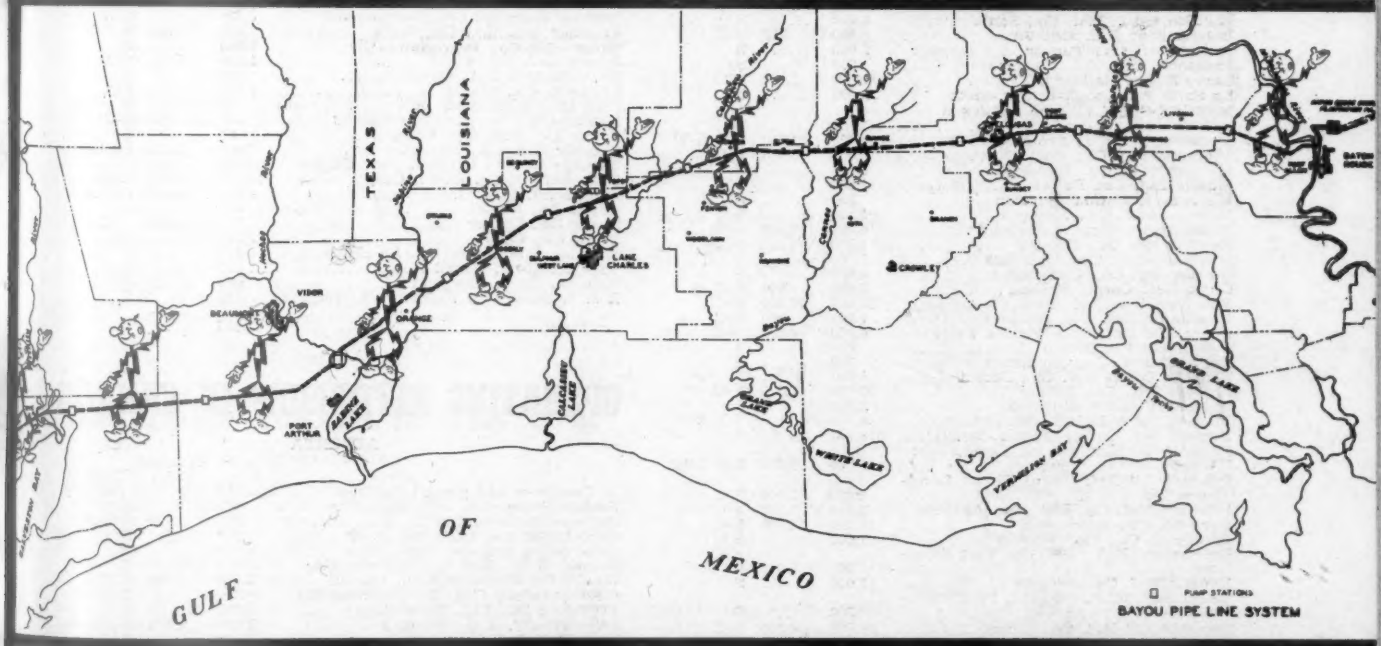
Gulf States Utilities Company also furnishes electric power to the terminal station of the Plantation Pipe Line System.


rubber industry further and to develop all possible quick sources of natural rubber to take care of the additional needs in 1944."

Bayou Pipe Line Project Completed

Completion of the Bayou Pipe Line project linking the Houston-Beaumont refining areas with the Plantation pipe line was reported February 19 by PAW, which said the new connection will permit an increase of 30,000 barrels daily in deliveries of gasoline or kerosene at Greensboro, North Carolina.

THE OIL WEEKLY • February 22, 1943



GULF STATES UTILITIES CO.

General Offices: Beaumont, Texas, Lake Charles and Baton Rouge, Louisiana

DEPENDABLE GULF STATES UTILITIES CO. SERVICE

RHODE ISLAND

Company and plant location—	Crude oil cap. bbl.	Cracked gaso. cap. bbl.	Type of refinery
Socony-Vacuum Oil Co., Inc., E. Providence	5,500	750	S-C-A
Texas Co., Providence	3,500	.....	S-A
Total	9,000	.....	

SOUTH CAROLINA

Standard Oil Co. of N. J., Charleston	6,000	.....	S-A

SOUTH DAKOTA

Belle Ref. Co., Belle Fourche	50	.....	S
Hot Springs Ref. Co., Hot Springs	200	.....	S
Rex Oil Refinery, Rapid City	50	.....	S
Sturgis Ref. Co., Sturgis	100	.....	S
Total	400		

TENNESSEE

Delta Ref. Co., Memphis	4,800	1,000	S-C-A

TEXAS

American Mineral Spirits Co., Corpus Christi	10,000	.....	S
American Republics Corp., Houston	6,500	.....	S
Atlantic Ref. Co., Atreco	23,900	9,500	S-C
Beacon Oil & Ref. Co., Henderson	3,000	.....	S
Baird Ref. Co., Baird	2,000	600	S-C
Bryson Pipe Line & Ref. Co., Bryson	2,500	.....	S-L
Coastal Refineries, Inc., Port Isabel	6,500	1,000	S-C
Col-Tex Ref. Co., Colorado City	10,000	1,750	S-C-A
Continental Oil Co., Wichita Falls	5,000	2,600	S-C
Cosden Pet. Corp., Big Spring	16,000	6,000	S-C
Cosden Pet. Corp., Graham	2,500	.....	S
Crown Central Pet. Corp., Houston	16,000	8,000	S-C-L
Danciger Oil & Refineries, Inc., Pampa	7,000	2,400	S-C
Eastern States Pet. Co., Inc., Houston	15,000	3,000	S-C
Gladewater Ref. Co., Gladewater	3,000	800	S-C
Golden West Oil Co., Hondo	100	.....	S
Gratex Ref. & Fuel Oil Co., Graham	500	.....	S
Gulf Oil Corp., Fort Worth	7,200	4,000	S-C
Gulf Oil Corp., Port Arthur	153,600	75,000	S-C-L-W
Gulf Oil Corp., Sweetwater	6,400	4,000	S-C
Hammon Oil & Ref. Co., Bay City	3,000	.....	S
Heffington Pet. Co., Austin	200	.....	S
Houston Oil Co. of Texas, Viola	500	.....	S
Humble Oil & Ref. Co., Baytown	175,000	57,000	S-C-L-A
Humble Oil & Ref. Co., Ingleside	30,000	8,500	S-C
Humble Oil & Ref. Co., San Antonio	6,200	.....	S
Independent Ref. Co., Arp.	3,500	750	S-C
Inland Ref. Co., Tucker	2,000	.....	S
Jacksboro Ref. Co., Jacksboro	250	.....	S
Lacy, Roger, Refinery, Kilgore	2,500	1,000	S-C
La Salle Pet. Corp., Burkburnett	2,500	.....	S
McBride Ref. Co., Inc., LaBlanca (Edinburg)	1,200	.....	S
Magnolia Pet. Co., Beaumont	105,000	27,500	S-C-L-W
Magnolia Pet. Co., Fort Worth	12,000	5,400	S-C
Maritime Oil Co., Houston	5,000	.....	S
Master Pet. Co., Dallas	1,500	.....	S
Mertzon Ref. Co., Mertzon	200	.....	S
Minerva Ref. Co., Minerva	1,250	.....	S
Motor Fuels Corp., Levelland	4,000	2,600	S-C
Moutray Oil Co., Hawley	1,000	130	S-C
Muenster Ref. Co., Muenster	1,500	.....	S
Nueces Ref. Co., Clarkwood	2,500	.....	S
Onyx Ref. Corp., Abilene	2,000	800	S-C
Pan American Ref. Corp., Texas City	97,000	27,000	S-C
Panhandle Ref. Co., Lueders	1,500	400	S-C
Panhandle Ref. Co., Wichita Falls	4,000	960	S-C
Patton Oil Co., Rotan	800	.....	S
Payward Ref. Co., Shamrock	700	.....	S
Phoenix Oil & Ref. Co., Pettus	1,000	.....	S
Phillips Pet. Co., Borger	39,000	17,000	S-C
Phoenix Ref. Co., Houston	2,500	.....	S
Pioneer Oil & Ref. Co., Somerset	1,400	.....	S-L-A
Pontiac Ref. Corp., Corpus Christi	10,500	.....	S
Premier Oil Ref. Co. of Texas, Fort Worth	5,000	1,500	S-C-L-W
Premier Oil Ref. Co. of Texas, Longview	4,500	2,500	S-C
Prichard Ref. Co., Ltd., San Antonio	3,000	1,000	S-C
Pure Oil Co., Nederland	48,700	14,800	S-C
Rado Ref. Co., McAllen	1,000	.....	S
Reischman, R. T., Ref. Co., Fort Stockton	500	.....	S
Refugio Ref. Co., Refugio	1,000	.....	S
Reischman, R. J., Ref. Co., Fort Stockton	500	.....	S
Republic Oil Ref. Co., Texas City	20,000	4,500	S-C
Shamrock Oil & Gas Corp., Sunray	3,000	2,000	S-C
Shell Oil Co., Inc., Houston	74,000	21,900	S-C
Shelly Ref. Co., Inc., Bay City	1,700	210	S-C
Sinclair Ref. Co., Corpus Christi	12,000	.....	S
Sinclair Ref. Co., Fort Worth	6,200	1,700	S-C
Sinclair Ref. Co., Houston	73,000	18,000	S-C-L-W
Skelly Oil Co., Longview	10,000	2,600	S-C
Southport Pet. Co. of Del., Texas City	20,000	1,200	S-C
Southwestern Oil & Ref. Co., Corpus Christi	14,000	.....	S-L
Standard Oil Co. of Texas, El Paso	14,000	2,500	S-C
Star Light Ref. Co., Inc., Ballinger	600	.....	S
Stone Oil Co., Texas City	7,500	.....	S
Talco Asphalt & Ref. Co., Mount Pleasant	10,000	3,000	S-C-A
Taylor Ref. Co., Corpus Christi	22,500	2,000	S-C
Texas Co., Amarillo	7,500	2,400	S-C
Texas Co., El Paso	2,500	1,000	S-C
Texas Co., Houston	27,500	1,000	S-C
Texas Co., Port Arthur	135,000	52,000	Comp.
Texas Co., Port Neches	40,000	.....	S-A
Texas Co., San Antonio	6,000	2,200	S-C
Texas Co., West Dallas	15,000	7,000	S-C
Texas Pacific Coal & Oil Co., Caddo	400	.....	S
Three Rivers Ref., Three Rivers	1,500	.....	S-L-A
Tydal Ref. Co., Gainesville	1,500	.....	S
Uvalde Rock Asphalt Co., Blewett	500	.....	S
Waggoner, W. T., Eestate, Electra	4,000	1,200	S-C
Western Ref. Co., Fort Stockton	1,000	.....	S
Wickett Ref. Co., Wickett	4,000	.....	S
Total	1,417,000	.....	

UTAH

Equity Oil Co., Vernal (Jensen)	500	.....	S
Utah Oil Ref. Co., Salt Lake City	9,500	2,550	Comp.
Wasatch Oil Ref. Co., Woods Cross	2,500	900	S-C-A
Total	12,500	.....	

VIRGINIA

Texas Co., Norfolk	2,000	.....	S-A

WASHINGTON

Inland Empire Refineries, Inc., Spokane	5,000	1,200	S-C-A
Montana Headlight Oil Co., Spokane	1,000	.....	S
Total	6,000	.....	

WEST VIRGINA

Carbide & Carbon Chemicals Corp., South Charleston	3,500	600	S-C-L-W
Elk Refining Co., Falling Rock	3,500	1,500	T-V-P
Pure Oil Co., Cabin Creek	5,500	1,490	S-C-L-W
Quaker State Oil Ref. Co., St. Marys	2,500	1,200	S-C-L-W
Total	15,000	.....	

WISCONSIN

Wisconsin Oil Ref. Co., Inc., Sheboygan	5,000	.....	S

WYOMING

C. & H. Refinery, Lusk	80	.....	S
Continental Oil Co., Glenrock	3,400	1,800	S-C
Consumers Oil & Ref. Co., Newcastle	1,500	950	S
Crook County Refinery, Sundance	80	.....	S
Douglas Ref., Douglas	120	.....	S
Elk Horn Gas Refinery, Osage	55	.....	S
Empire State Oil Co., Thermopolis	3,200	.....	S-A
Frontier Ref. Co., Cheyenne	1,600	520	S-C
Gray Refinery, Inc., Newcastle	1,000	.....	S
Husky Ref. Co., Cody	2,500	.....	S-A
Northwestern Pet., Osage	100	.....	S
Ohio Oil Co., Lovell	3,000	.....	S-A
Pilot Oil Co., Morton	250	.....	S
Resolute Oil Corp., Badger Basin	800	200	S-C
Silver Tip Refinery, Yoder	95	.....	S
Sinclair Ref. Co., Sinclair	9,000	2,900	S-C-A
Socony-Vacuum Oil Co., Inc., Casper	5,000	1,000	S-C-A
Standard Oil Co. (Ind.), Casper	13,000	3,800	Comp.
Standard Oil Co. (Ind.), Greybull	4,100	1,000	S-C-A
Texas Co., Calpet	400	.....	S
Texas Co., Casper	7,000	3,800	S-C
Texas Co., Cody	3,000	.....	S-A
Wasatch Production Co., La Barge	125	.....	S
Yale Oil Corp., Lovell	1,000	.....	S-A
Yale Oil Corp., Worland	500	.....	S
Z & W Service & Refinery, Torrington	100	.....	S
Total	61,055	.....	

OPERATING REFINERIES IN CANADA

ALBERTA

Company and plant location—	Crude oil cap. bbl.	Cracked gaso. cap. bbl.	Type of refinery
Becker Refineries, Ltd., Royalties	500	.....	S
British-American Oil Co., Ltd., Calgary	5,000	2,500	S-C-A
Comet Ref. Co., Ltd., Red River	250	.....	S
Dina Oil & Ref. Co., Ltd., Dina	500	.....	S
Fraser, J. W., Ref. Co., Wainwright	100	.....	S
Gas & Oil Products, Ltd., Hartell	2,500	600	S-C
Gold Standard Oils, Ltd., Wainwright	300	.....	S-A
Huff Ref. Co., Ltd., Lethbridge†	500	.....	S
Imperial Oil, Ltd., Calgary	7,500	2,000	S-C-L-A
Lion Ref. Co., Calgary†	500	.....	S-A
Munro, J. R., Hubalta	500	.....	S
Okotoks Oil & Ref. Co., Ltd., Okotoks	300	.....	S
Shaw Petroleums, Ref. Div., Lloydminster	300	.....	S-A
Warner Oil Ref. & Dist. Co., Warner	500	.....	S
Total	19,250	.....	

BRITISH COLUMBIA

Home Oil Distributors, Ltd., N. Vancouver*	2,000	.....	S
Imperial Oil, Ltd., Ioco	32,500	600	S-C-L-A
Shell Oil Co. of B. C., Shelburn	4,200	.....	S
Standard Oil Co. of B. C., Ltd., Burnaby	4,500	.....	S-A
Total	43,200	.....	

*Shut down.

MANITOBA

Company and plant location—	Crude oil cap. bbl.	Cracked gaso. cap. bbl.	Type of refinery
Anglo-Canadian Oils, Ltd., Brandon	1,400	*500	S-C-A
Carman Oil Ref., Ltd., Carman†	250	.....	S
Mid-West Refineries, Ltd., Dauphin	200	.....	S
North Star Oil, Ltd., St. Boniface	1,200	600	S-C
Radio Oil Ref., Ltd., Winnipeg	700	.....	S
Total	3,750	.....	

NEW BRUNSWICK

New Brunswick Gas & Oilfields, Ltd., Weldon	300	.....	S

NORTHWEST TERRITORIES

Northwest Co., Ltd., Fort Norman	850	.....	S

NOVA SCOTIA

Imperial Oil, Ltd., Halifax	32,500	3,400	S-C-A

ONTARIO

British-American Oil Co., Ltd., Toronto	6,000	3,000	S-C
Burlington Refineries, Ltd., Hamilton*	600	.....	S
Canadian Oil Companies, Ltd., Petrolia	4,000	1,500	S-C-L-W
Good Rich Ref. Co., Ltd., Port Credit	4,000	600	S-C
Imperial Oil, Ltd., Sarnia	41,000	10,350	Comp.
McColl-Frontenac Oil Co., Ltd., Toronto	12,000	7,000	S-C
Total	67,600	.....	

*Shut down.

QUEBEC

British-American Oil Co., Ltd., Montreal	12,000	7,500	S-C-A
Gen. Pet. Refineries, Pointe-aux-Trembles	300	.....	S
Imperial Oil, Ltd., Montreal	25,000	3,400	S-C-A
McColl-Frontenac Oil Co., Ltd., Montreal	20,000	12,000	S-C
Shell Oil Co. of Canada, Ltd., Montreal	7,500	5,000	S-C
Total	64,800	.....	

SASKATCHEWAN

British-American Oil Co., Ltd., Moose Jaw	4,000	2,000	S-C-A
Consumers Co-Op. Ref., Regina	1,500	500	S-C
Eston Ref. Co., Ltd., Eston	300	.....	S
Hi-Way Refineries, Ltd., Moose Jaw	300	.....	S
Hi-Way Refineries, Ltd., Saskatoon	300	.....	S
Hi-Way Refineries, Ltd., Rosetown	250	.....	S
Home Oil & Ref., Ltd., Humboldt	400	.....	S
Imperial Oil, Ltd., Regina	7,500	1,500	S-C-A
Northern Pet. Corp., Ltd., Kamsack	200	.....	S-L
Sterling Ref., Ltd., Yorkton	750	250	S
Total	15,500	.....	

OPERATING REFINERIES IN MEXICO

Petroleos Mexicanos, Ciudad Madero	63,000	8,500	Comp.
Petroleos Mexicanos, Arbol Grande	15,000	.....	S-L-W
Petroleos Mexicanos, Bella Vista	4,000	1,100	S-C
Petroleos Mexicanos, Mata Redonda	9,000	5,500	S-C
Petroleos Mexicanos, Poza Rica	7,500	.....	S
Petroleos Mexicanos, Minatitlan*	30,000	2,500	Comp.
Petroleos Mexicanos, Mexico City	20,000	.....	S
T. Meza Moreno, P. y Aguacate	315	.....	S
Refinerias Mexico, Nuevo Laredo	330	.....	S
Refineries Laredo, Nuevo Laredo	190	.....	S
Refineria Union, Monterrey	160	.....	S
Refineria del Norte, Cd. Juarez	1,000	.....	S
Total	150,495	.....	

*Operating skimming unit only.

SHUTDOWN PLANTS IN THE U. S.

CALIFORNIA

Company and plant location—	Crude oil cap. bbl.	Cracked gaso. cap. bbl.	Type of refinery
Aromalene, Inc., Long Beach	3,000	.....	S
East-West Ref. Co., Los Angeles	3,200	.....	S
El Camino Ref. Co., Los Alamitos	3,000	.....	S
General Pet. Corp. of Calif., Vernon	28,000	.....	S
Harbor Ref. Co., Long Beach	3,000	.....	S
Industrial Lubricants, Inc., Southgate	800	.....	S
Kern Oil Co., Ltd., Pico	4,000	.....	S
Kolingo Ref. Co., Coalinga	300	.....	S-A
Mangold & Tweedy Ref. Co., Long Beach	2,500	.....	S
Olympic Ref. Co., Long Beach	6,500	.....	S
Petrol Corp., Santa Maria	1,500	.....	S-A
Richfield Oil Corp., Hynes	55,000	14,000	S-C
Richfield Oil Corp., Vinvale	10,000	3,600	S-C
Signal Hill Ref. Co., Long Beach	3,500	.....	S
Solvents Ref. Co., Vinvale	750	.....	S
Yosemite Refinery, Bakersfield	2,000	.....	S
Total	127,050	.....	

ILLINOIS

Basin Oil Ref. Co., Centralia	2,000	.....	S
Centralia Ref. Co., Centralia	2,000	.....	S
Cross Co., Henry H., Joliet	1,000	.....	S
Fairfield Ref. Corp., Fairfield	1,800	.....	S
Total	6,800	.....	

KANSAS

Company and plant location—	Crude oil cap. bbl.	Cracked gaso. cap. bbl.	Type of refinery
Krueger Oil & Ref. Co., Natoma	150	.....	S
Roper Pet. Co., Parsons	750	.....	S
Zenith Ref. Co., Chase	3,000	.....	S
Total	3,900		

LOUISIANA

Shoreline Oil Co., Shoreline	5,000	2,200	S-C

MICHIGAN

Caro Refineries, Inc., Caro	1,000	.....	S
Hi-Way Ref. Co., Vernon (Rosebud)	500	.....	S
Mid-West Refineries, Inc., Grand Rapids	2,000	.....	S
Mid-West Refineries, Inc., Dewey	1,500	.....	S
Sovereign Ref. Co., Saginaw	1,200	.....	S
Titan Ref. Co., Plymouth	4,000	.....	S-A
Trumbull Asphalt & Ref. Co., Alma	1,000	.....	S-A
Total	11,200		

MISSISSIPPI

Johnson, E. C., Co., Vicksburg	4,000	.....	S

MONTANA

Arro Oil & Ref. Co., Lewistown	1,500	750	S-C
Bears Den Refinery, Bears Den	50	.....	S
Carroll, L. Ray, Roundup	100	.....	S
Deloraine Ref. Co., Oilmont	225	.....	S
Gallatin Farmers Co., Belgrade	240	.....	S
Gallop City Refinery, Conrad	60	.....	S
Hannah-Porter Co., Sweet Grass	400	.....	S
Home Oil & Ref. Co., Conrad	600	.....	S
North American Oil Ref. Co., Chinook	300	.....	S
Patterson, H. F., Ref. Co., Sweet Grass	800	.....	S
Sandgren & Nyhagen, Cut Bank	40	.....	S
Treasure State Ref. Co., Shelby	300	.....	S
Unity Pet. Co., Kalispell	1,000	250	A
Walgren, C. E., Cut Bank field	50	.....	S
Whitlash Ref. Co., Whitlash	30	.....	S
Yale Oil Corp., Kalispell	1,000	.....	S
Zoeller Refinery, Bears Den	50	.....	S
Total	6,745	.....	

NEW YORK

Gulf Oil Corp., Staten Island	13,000	.....	S

NEW JERSEY

Barber Asphalt Corp., Barber	13,500	1,600	S-C-A

NEW MEXICO

Pecos Diamond Ref. Co., Inc., Artesia	325	.....	S

OHIO

Canton Ref. Co., Canton	10,000	2,000	S-C
Panda Oil & Ref. Co., Toledo	3,500	.....	S-A
Total	13,500	.....	

OKLAHOMA

Cities Service Oil Co. (Del.), Okmulgee	4,000	600	S-C-L-W
Eason Oil Co., Enid	5,000	.....	S
Globe Oil & Refining Co. (Okla.), Blackwell	8,000	4,000	S-C
Knox Ref. Co., Covington	500	.....	S
Omar Ref. Co., Garber	5,000	2,000	S-C
Pilgrim, Inc., Kingston	50	.....	S-L
Sun Oil Co., Yale	5,000	.....	S
Total	27,550	.....	

TENNESSEE

Russell Producing Co., Sunbright	150	.....	S

TEXAS

Caprito Ref., Post*	500	.....	S
Delta Ref. Co., Sullivan City	500	.....	S
Danciger Oil & Ref. Co., Longview	7,000	2,400	S-C
Howard County Ref. Co., Big Spring	2,000	.....	S
Humble Oil & Ref. Co., Neches	5,000	.....	S
McMurrey Ref. Co., Tyler	6,000	1,500	S-C
Olney Oil & Ref. Co., Wichita Falls	2,000	900	S-C
Phillips Pet. Co., Penwell	1,000	750	S-C
Phoenix Ref. Co., Waco	1,500	.....	S
Tucker Oil Co., Burkburnett	250	.....	S
Total	25,750	.....	

*Runs about 6,000 bbl. a year.

UTAH

Quaker Pet. Corp., Virgin*	200	.....	S

*Leased from Diamond Oil Co.

WYOMING

Albany Oil & Ref. Co., Laramie	120	.....	S
Beck Refinery, Cody	500	.....	S
Davis Oil Co., Newcastle	75	.....	S
Moorcroft Ref. Co., Moorcroft	60	.....	S
Ralston Refinery, Upton	50	.....	S
Salt Creek Refinery, Columbine (Casper)	200	.....	S
Tri-State, Inc., Thermopolis	1,000	.....	S-C-A
Upton Refinery, Upton	110	.....	S
Whitman, A. J., Leroy	200	.....	S
Total	2,315	.....	

COLORADO

Midland Oil Ref. Co., Denver	1,000	.....	S-A
Universal Refineries, Pueblo	1,000	.....	S
Total	2,000	.....	

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Carborundum Co., Niagara Falls, N. Y.
Illinois Minerals Co., Cairo, Ill.
Norton Co., Worcester, Mass.
Pangborn Corp., Hagerstown, Md.
U. S. Rubber Co., 1230 Sixth Ave., New York City

ABSORBERS:
American Locomotive Co., Alco Products Div., 30 Church St., New York City
Babcock & Wilcox Tube Co., The, 85 Liberty St., New York City
Beaird Corp., J. B. Shreveport, La.
Bethlehem Steel Co., Bethlehem, Pa.
Biggs Boiler Works, The, Akron, Ohio
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Braun, C. F., & Co., Alhambra, Calif.
Combustion Engineering Co., Inc., 200 Madison Ave., New York City
Devine, J. P., Mfg. Co., Mount Vernon, Ill.
Fluor Corp., Ltd., Box 7030, Los Angeles, Calif.
Foster Wheeler Corp., 165 Broadway, New York City
Gasoline Plant Construction Co., Houston, Tex.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Hudson Engineering Co., Houston, Tex.
Lancaster Iron Works, Lancaster, Pa.
McKee, Arthur G., & Co., Cleveland, Ohio
McNamar Boiler & Tank Co., Tulsa, Okla.
National Tank Co., Tulsa, Okla.
Peabody Engineering Corp., 580 Fifth Ave., New York City
Standard Steel Corp., Los Angeles, Calif.
Stearns-Roger Manufacturing Co., Denver, Colo.
Southwest Welding & Mfg. Co., Alhambra, Calif.
Struthers-Wells, Warren, Pa.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Vulcan Steel Tank Corp., Tulsa, Okla.
Watkins, Inc., Wichita, Kans.
Wyatt Metal & Boiler Works, Houston, Tex.

ABSORBERS—Ammonia:
Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Hendrick Mfg. Co., Carbondale, Pa.
Lancaster Iron Works, Lancaster, Pa.
Southwestern Engineering Co., Los Angeles, Calif.
Standard Steel Corp., Los Angeles, Calif.
Worthington Pump & Machinery Corp., Harrison, N. J.
Wyatt Metal & Boiler Works, Houston, Tex.

ACCUMULATORS—Steam:
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Foster Wheeler Corp., 165 Broadway, New York City
Hudson Engineering Co., Houston, Tex.
Kieley & Mueller, Inc., North Bergen, N. J.
Lancaster Iron Works, Lancaster, Pa.
Patterson-Kelley Co., Inc., The, East Stroudsburg, Pa.
McKee, Arthur G., & Co., Cleveland, Ohio
Standard Steel Corp., Los Angeles, Calif.
Watkins, Inc., Wichita, Kans.
Wyatt Metal & Boiler Works, Houston, Tex.

ACETYLENE:
Air Reduction Sales Co., 60 E. 42nd St., New York City
Linde Air Products Co., 30 E. 42nd St., New York City
National Cylinder Gas Co., 205 W. Wacker, Chicago, Ill.

ACETYLENE GENERATORS:
Air Reduction Sales Co., 60 E 42nd St., New York City
Linde Air Products Co., 30 E. 42nd St., New York City
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Sight Feed Generator Co., Richmond, Ind.

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Harshaw Chemical Co., Columbus, Ohio
Monsanto Chemical Co., St. Louis, Mo.
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.

ACID-TREATING EQUIPMENT—See Specific Equipment:

ADSORBENTS:
Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
Attapulgus Clay Co., 260 Broad St., Philadelphia, Pa.
Carbide & Carbon Chem. Corp., 30 E. 42nd St., New York City
Floridin Co., Warren, Pa.
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ACID—Sulphuric:
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General Chemical Co., 40 Rector St., New York City
Monsanto Chemical Co., St. Louis, Mo.
New Jersey Zinc Co., 160 Front St., New York City
Ozark Chemical Co., Tulsa, Okla.
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.

AFTER-COOLERS:
American Locomotive Co., Alco Products Div., 30 Church St., New York City
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Bethlehem Steel Co., Bethlehem, Pa.
Biggs Boiler Works, The, Akron, Ohio
Braun, C. F., & Co., Alhambra, Calif.
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Bury Compressor Co., Erie, Pa.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Coy Co., Jos. A., Inc., Tulsa, Okla.
Devine, J. P., Mfg. Co., Mount Vernon, Ill.
Engineers & Fabricators, Inc., Houston, Tex.
Foster Wheeler Corp., 165 Broadway, New York City
Griscom-Russell Co., The, 285 Madison Ave., New York City
Ingersoll-Rand Co., 11 Broadway, New York City
National Radiator Co., The, Johnstown, Pa.

Patterson-Kelley Co., Inc., The, East Stroudsburg, Pa.
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Southwest Welding & Mfg. Co., Alhambra, Calif.
Southwestern Engineering Co., Los Angeles, Calif.
Struthers-Wells, Warren, Pa.
Sullivan Machinery Co., Michigan City, Ind.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Vogt, Henry, Machine Co., Louisville, Ky.
Whitlock Mfg. Co., The, Hartford, Conn.
Worthington Pump & Machinery Corp., Harrison, N. J.
Wyatt Metal & Boiler Works, Houston, Tex.
Zallea Bros. & Johnson, 316 Locust St., Wilmington, Del.

AGITATORS—Propeller Type:

Alsop Engineering Co., Milldale, Conn.
Eastern Engr. Co., New Haven, Conn.
Haveg Corp., Newark, Del.
Mixing Equipment Co., Inc., Rochester, N. Y.
New England Tank & Tower Co., Everett, Mass.
Patterson Foundry & Machine Co., E. Liverpool, Ohio
Turbo-Mixer Corp., The, New York City

AGITATORS—Tank Type:

Bethlehem Foundry & Machine Co., Bethlehem, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Blickman, S., Inc., Weehawken, N. J.
Chicago Bridge & Iron Co., 332 S. Michigan Ave., Chicago, Ill.
Frick Co., Waynesboro, Pa.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Graver Tank & Mfg. Co., 4909 Todd, East Chicago, Ind.
Hendrick Mfg. Co., Carbondale, Pa.
McKee, Arthur G., & Co., Cleveland, Ohio
McNamar Boiler & Tank Co., Tulsa, Okla.
Morrison Brothers, Dubuque, Iowa
Muskegon Boiler Works, Muskegon, Mich.
Oxley Engineering Co., Ltd., London, England
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Patterson-Kelley Co., Inc., The, East Stroudsburg, Pa.
Porter, H. K., Co., Inc., Pittsburgh, Pa.
Southwest Welding & Mfg. Co., Alhambra, Calif.
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Turbo-Mixer Corp., New York City
Watkins, Inc., Wichita, Kans.
Wyatt Metal & Boiler Works, Houston, Tex.

AIR CLEANERS—See FILTERS, Air:

AIR COMPRESSORS—See COMPRESSORS, Air:

AIR FILTERS—See FILTERS, Air:

AIR EJECTORS—See EJECTORS, Air:

AIR MOTORS—See MOTORS, Air:

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ALARMS—Combustible Gas:

Davis Emergency Equipment Co., Inc., Newark, N. J.
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ALLOYS—Chrome and Chrome-Nickel:

Alan Wood Steel Co., Conshohocken, Pa.
Allegheny Ludlum Steel Co., Pittsburgh, Pa.
American Manganese Steel Div., 389 E. 14th St., Chicago Heights, Ill.
Arcos Corp., 401 N. Broad St., Philadelphia, Pa.
Carnegie-Illinois Steel Corp., 434 Fifth Ave., Pittsburgh, Pa.
Carpenter Steel Co., Reading, Pa.
Duraloy Co., The, Scottdale, Pa.
Duriron Co., The., Inc., Dayton, Ohio
Hadfields Limited, London, Eng.
International Nickel Co., 67 Wall St., New York City
Jorgenson, Earle M., Co., Houston, Tex.
Lebanon Steel Foundry, Lebanon, Pa.
Ohio Steel Foundry Co., The, Springfield, Ohio
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Standard Alloy Co., 1679 Collamer Rd., Cleveland, Ohio

ALLOYS—Copper:

Alan Wood Steel Co., Conshohocken, Pa.
American Brass Co., 25 Broadway, New York City
Ampco Metals, Inc., Milwaukee, Wis.
Beryllium Corp. of Pennsylvania, Reading, Pa.
Bunting Brass & Bronze Co., Toledo, Ohio
Carnegie-Illinois Steel Corp., 434 Fifth Ave., Pittsburgh, Pa.
Chase Brass & Copper Co., Waterbury, Conn.
Gilbert Brass Foundry Co., St. Louis, Mo.
Hadfields Limited, London, Eng.
Progressive Brass Mfg. Co., Tulsa, Okla.
Scovill Mfg. Co., Waterbury, Conn.
Shenango-Penn Mold Co., Dover, Ohio
Wheatley Brothers, Tulsa, Okla.

ALLOYS—Corrosion Resisting:

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Alloy Steel Products Co., Inc., Linden, N. J.
Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
American Brass Co., 25 Broadway, New York City
American Manganese Steel Div., 389 E. 14th St., Chicago Heights, Ill.
Ampco Metals, Inc., Milwaukee, Wis.
Bethlehem Steel Co., Bethlehem, Pa.
Bridgeport Brass & Copper Co., Bridgeport, Conn.
Bunting Brass & Bronze Co., Toledo, Ohio
Burgess-Parr Co., Freeport, Ill.
Carnegie-Illinois Steel Corp., 434 Fifth Ave., Pittsburgh, Pa.
Carpenter Steel Co., Reading, Pa.
Carson Cadillac Corp., Birmingham, Ala.
Chase Brass & Copper Co., Waterbury, Conn.
Copper Alloy Foundry Co., The, Elizabeth, N. J.
Duraloy Co., The, Scottdale, Pa.
Duriron Co., The, Inc., Dayton, Ohio
Electro Metallurgical Co., 30 E. 42nd St., New York City
Hadfields Limited, London, Eng.
Haynes Stellite Co., Kokomo, Ind.
International Nickel Co., 67 Wall St., New York City
Jorgenson, Earle M., Co., Houston, Tex.
Lebanon Steel Foundry, Lebanon, Pa.
National Lead Co. 111 Broadway, New York City
Republic Steel Corp., Republic Bldg., Cleveland, Ohio
Revere Copper & Brass, Inc., 230 Park Ave., New York City
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Scovill Mfg. Co., Waterbury, Conn.
Shenango-Penn Mold Co., Dover, Ohio
Sivyer Steel Casting Co., Milwaukee, Wis.
Standard Alloy Co., 1679 Collamer Rd., Cleveland, Ohio
Wall-Colmonoy Corp., Buhl Bldg., Detroit, Mich.
Watkins, Inc., Wichita, Kans.
Weber Engine Works, Kansas City, Mo.
Youngstown Sheet & Tube Co., The, Youngstown, Ohio

ALLOYS—Hard Surfacing:

American Manganese Steel Div., 389 E. 14th St., Chicago Heights, Ill.
Carnegie-Illinois Steel Corp., Carnegie Bldg., Pittsburgh, Pa.
Central Steel & Wire Co., 4545 S. Western Blvd., Chicago, Ill.
Chicago Steel & Wire Co., 103rd St. and Torrance Ave., Chicago, Ill.
Crucible Steel Co. of America, 405 Lexington Ave., New York City
Diamond Metal Co., Houston, Tex.
Fahralloy Co., The, 150th St. and Lexington Ave., Chicago, Ill.
Gulf Coast Machine & Supply Co., Beaumont, Tex.
Harnischfeger Corp., Milwaukee, Wis.
Haynes Stellite Co., Kokomo, Ind.
Jorgenson, Earle M., Co., 5311 Clinton Drive, Houston, Tex.
Linde Air Products Co., The, 30 E. 42nd St., New York City
Mills Alloys, Inc., 11320 S. Alameda St., Los Angeles, Calif.
National Cylinder Gas Co., 205 W. Wacker Drive, Chicago, Ill.
Osage Metal Co., Inc., Oklahoma City, Okla.
Republic Steel Corp., Cleveland, Ohio
Stoody Co., Whittier, Calif.
Youngstown Sheet & Tube Co., Youngstown, Ohio

ALLOYS—Molybdenum:

Bethlehem Steel Co., Bethlehem, Pa.
Carnegie-Illinois Steel Corp., 434 Fifth Ave., Pittsburgh, Pa.
Carpenter Steel Co., Reading, Pa.
Duraloy Co., The, Scottdale, Pa.
Hadfields Limited, London, Eng.
Jorgenson, Earle M., Co., Houston, Tex.
Lebanon Steel Foundry, Lebanon, Pa.
Molybdenum Corp. of America, Pittsburgh, Pa.
Ohio Steel Foundry Co., The, Springfield, Ohio
Republic Steel Corp., Republic Bldg., Cleveland, Ohio
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Standard Alloy Co., 1679 Collamer Rd., Cleveland, Ohio

ALLOYS—Nickel:

Alan Wood Steel Co., Conshohocken, Pa.
American Brass Co., Waterbury, Conn.
Carnegie-Illinois Steel Corp., 434 Fifth Ave., Pittsburgh, Pa.
Carpenter Steel Co., Reading, Pa.
Chase Brass & Copper Co., Waterbury, Conn.
Copper Alloy Foundry Co., The, Elizabeth, N. J.
Duraloy Co., The, Scottdale, Pa.
Duriron Co., The, Inc., Dayton, Ohio
Hadfields Limited, London, Eng.
International Nickel Co., 67 Wall St., New York City
Jorgeson, Earle M., Co., Houston, Tex.
Ohio Steel Foundry Co., The, Springfield, Ohio
Republic Steel Corp., Republic Bldg., Cleveland, Ohio
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Scovill Mfg. Co., Waterbury, Conn.
Shenango-Penn Mold Co., Dover, Ohio
Wall-Colmonoy Corp., Buhl Bldg., Detroit, Mich.
Youngstown Sheet & Tube Co., The, Youngstown, Ohio

AMMONIA COMPRESSORS—See COMPRESSORS, Ammonia:

AMMONIA:

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Mathieson Alkali Works, Inc., 60 E. 42nd St., New York City
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.

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Chance, A. B., Co., The, Centralia, Mo.
Copperweld Steel Co., Glassport, Pa.
Dillon, W. C., & Co., Inc., 5410 W. Harrison, Chicago, Ill.
Everstick Anchor Co., Fairfield, Iowa
Grip-Tite Mfg. Co., Winterset, Iowa
Kearney, James R., Corp., St. Louis, Mo.
Mastergrip Utilities Supply Corp., St. Louis, Mo.
Oliver Iron & Steel Corp., 1001 Muriel St., Pittsburgh, Pa.
Texas Creosoting Co., Orange, Tex.

ARCHES—Furnace:

Armstrong Cork Co., Lancaster, Pa.

Bigelow-Liptak Corp., 2842 W. Grand Blvd., Detroit, Mich.
Detrick, M. H., Co., 140 S. Dearborn, Chicago, Ill.
Furnace Economy Co., 201 N. Wells St., Chicago, Ill.
Kellogg Co., The M. W., 225 Broadway, New York City
Laclede Christy Clay Products Co., St. Louis, Mo.
Lummus Co., The, 420 Lexington Ave., New York City
McLeod & Henry Co., Troy, N. Y.
Mexico Refractories Co., Mexico, Mo.
North American Refractories Co., Cleveland, Ohio
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.

ARCHES—Suspended:
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Bigelow-Liptak Corp., 2842 W. Grand Blvd., Detroit, Mich.
Detrick, M. H., Co., 140 S. Dearborn, Chicago, Ill.
Furnace Economy Co., 201 N. Wells St., Chicago, Ill.
Kellogg Co., The M. W., 225 Broadway, New York City
Laclede Christy Clay Products Co., St. Louis, Mo.
McLeod & Henry Co., Troy, N. Y.
Mexico Refractories Co., Mexico, Mo.
North American Refractories Co., Cleveland, Ohio
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.

AROMATIZATION—See PROCESSES, Refining:

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Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Burgess Battery Co., Acoustic Div., 2823-J W. Roscoe St., Chicago, Ill.
Engineering Specialties Co., 39 Cortlandt St., New York City

ARRESTERS—Flame, Tank:
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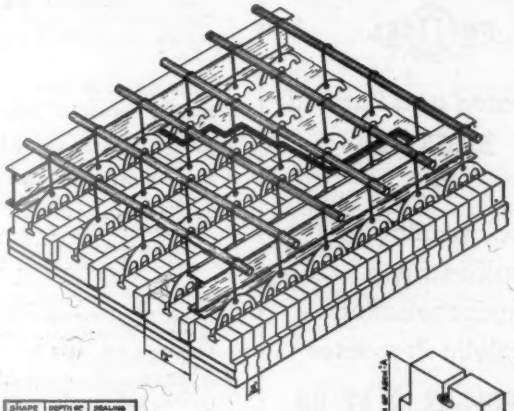

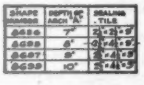

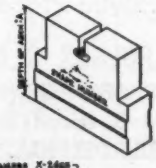

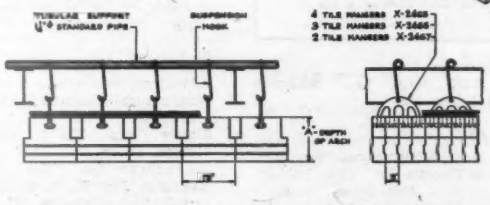

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Jones, W. A., Foundry & Machine Co., 4401 W. Roosevelt Rd., Chicago, Ill.
Link-Belt Co., 519 N. Holmes Ave., Indianapolis, Ind.
Magnolia Metal Co., Elizabeth, N. J.
Medart Co., St. Louis, Mo.
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Consolidated Bearings Co., Inc., East Orange, N. J.
Dodge Mfg. Co., Mishawaka, Ind.
Fafnir Bearing Co., New Britain, Conn.
Gwilliam Co., 360 Furman St., Brooklyn, N. Y.
Hoover Ball & Bearing Co., Ann Arbor, Mich.
Link-Belt Co., 519 N. Holmes Ave., Indianapolis, Ind.
McGill Mfg. Co., Valparaiso, Ind.
Marlin-Rockwell Corp., Jamestown, N. Y.
New Departure Div. (General Motors Corp.), Bristol, Conn.
Norma-Hoffman Bearings Corp., Stamford, Conn.
Shafer Bearing Corp., 35 E. Wacker Dr., Chicago, Ill.
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Torrington Co., The, Torrington, Conn.
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Dodge Mfg. Co., Mishawaka, Ind.
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Federal-Mogul Corp., Shoemaker and Lillibridge Sts., Detroit, Mich.
Gilbert Brass Foundry Co., St. Louis, Mo.
Green Fuel Economizer Co., Inc., Beacon, N. Y.
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Johnson Bronze Co., New Castle, Pa.
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Gatke Corp., 228 N. La Salle St., Chicago, Ill.
Richardson Co., The, Melrose Park, Ill.
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Medart Co., The, St. Louis, Mo.
Norma-Hoffman Bearings Corp., Stamford, Conn.
Orange Roller Bearing Co., Inc., Orange, N. J.
Roller Bearing Co. of America, Trenton, N. J.
Rollway Bearing Co., Inc., Syracuse, N. Y.
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Tillson Bearings Corp., L'Anse, Mich.
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Baldwin-Duckworth Div., Chain Belt Co., Springfield, Mass.
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Diamond Chain & Mfg. Co., Indianapolis, Ind.
Emsco Derrick & Equipment Co., 6701 S. Alameda St., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio
Link-Belt Co., 220 S. Belmont Ave., Indianapolis, Ind.
Morse Chain Co., Ithaca, N. Y.
Union Chain & Mfg. Co., Sandusky, Ohio
Whitney Chain & Mfg. Co., Hartford, Conn.

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Audubon Wire Cloth Corp., Castor Ave., and Richmond St., Philadelphia, Pa.
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Goodyear Tire & Rubber Co., Akron, Ohio
Gustin-Bacon Mfg. Co., Kansas City, Mo.
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Imperial Belting Co., 1750 S. Kilbourn, Chicago, Ill.
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Manheim Mfg. & Belting Co., Manheim, Pa.
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Russell Manufacturing Co., Middletown, Conn.
Scandinavia Belting Co., Charlotte, N. C.
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Ton-Tex Corp., Grand Rapids, Mich.
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Cincinnati Rubber Mfg. Co., The, Norwood Sta., Cincinnati, Ohio
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Gates Rubber Co., Denver, Colo.
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Manheim Mfg. & Belting Co., Manheim, Pa.
Medart Co., St. Louis, Mo.
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Rockwood Mfg. Co., Indianapolis, Ind.
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Thermoid Co., Trenton, N. J.
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Ilg Electric Ventilating Co., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City
Jeffrey Mfg. Co., The, Columbus, Ohio
National Machine Works, 1559 N. Sheffield, Chicago, Ill.
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Combustion Engineering Co., Inc., 200 Madison Ave., New York City
Edge Moore Iron Works, Inc., 30 Rockefeller Plaza, New York City
Farrar & Trefts, Inc., Buffalo, N. Y.
Foster Wheeler Corp., 165 Broadway, New York City
Kewanee Boiler Corp., Kewanee, Ill.
Lucey Boiler & Mfg. Co., Chattanooga, Tenn.
Murray Iron Works Co., Burlington, Iowa
Oil Well Supply Co., Dallas, Tex.
Porter, H. K., Co., Inc., Pittsburgh, Pa.
Preferred Utilities Co., Inc., New York City
Riley Stoker Corp., Worcester, Mass.
Standard Steel Works, Los Angeles, Calif.
Union Iron Works, Erie, Pa.
Vogt, Henry, Machine Co., Louisville, Ky.
Wickes Boiler Co., Saginaw, Mich.

BOILERS—Water Tube:
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Combustion Engineering Co., Inc., 200 Madison Ave., New York City
Edge Moore Iron Works, Inc., 30 Rockefeller Plaza, New York City
Foster Wheeler Corp., 165 Broadway, New York City
Murray Iron Works Co., Burlington, Iowa
Riley Stoker Corp., Worcester, Mass.
Standard Steel Corp., Los Angeles, Calif.
Union Iron Works, Erie, Pa.
Vogt, Henry, Machine Co., Louisville, Ky.
Wickes Boiler Co., Saginaw, Mich.

BOLTS—Machine:
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Nut & Bolt Co., Inc., Bridgeport, Conn.
Erie Bolt & Nut Co., Erie, Pa.
Lamson & Sessions Co., 1971 W. 85th St., Cleveland, Ohio
Oliver Iron & Steel Corp., 1001 Muriel St., Pittsburgh, Pa.
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
St. Louis Screw & Bolt Co., St. Louis, Mo.
Sheffield Steel Corp., Kansas City, Mo.
Standco Bolt Co., Houston, Tex.
Victor Products Corp., 2631 Belmont, Chicago, Ill.
Watkins, Inc., Wichita, Kans.

BOLTS—Steel:
Bethlehem Steel Co., Bethlehem, Pa.
Erie Bolt & Nut Co., Erie, Pa.
Lamson & Sessions Co., 1971 W. 85th St., Cleveland, Ohio
Oliver Iron & Steel Corp., 1001 Muriel St., Pittsburgh, Pa.
Republic Steel Corp., Republic Bldg., Cleveland, Ohio
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
St. Louis Screw & Bolt Co., St. Louis, Mo.
Sheffield Steel Corp., Kansas City, Mo.
Standco Bolt Co., Houston, Tex.
Victor Products Corp., 2631 Belmont, Chicago, Ill.

BOMBS—Vapor Pressure:
Daniel Orifice Fitting Co., 3352 Union Pacific Ave., Los Angeles, Calif.
Refinery Supply Co., Tulsa, Okla.
Shand & Jurs Co., Berkeley, Calif.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Vapor Recovery Systems Co., The, Compton, Calif.

BOOSTERS—Gas—See COMPRESSORS:

BOXES—Annealing:
American Manganese Steel Div., 389 E. 14th St., Chicago Heights, Ill.
Biggs Boiler Works, The, Akron, Ohio
Blaw-Knox Co., Blawnox, Pa.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Ohio Steel Foundry Co., The, Springfield, Ohio

BOXES—Condenser:
Biggs Boiler Works, The, Akron, Ohio
Birmingham Tank Co., Birmingham, Ala.
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Chicago Bridge & Iron Co., 332 S. Michigan Ave., Chicago, Ill.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Mosher Steel Co., Houston, Tex.
Muskegon Boiler Works, Muskegon, Mich.
National Radiator Co., The, Johnstown, Pa.
Oxley Engineering Co., Ltd., London, Eng.
Stacey Mfg. Co., The, Cincinnati, Ohio
Standard Steel Corp., Los Angeles, Calif.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Vulcan Steel Tank Corp., Tulsa, Okla.
Watkins, Inc., Wichita, Kans.
Wyatt Metal & Boiler Works, Houston, Tex.
Zallea Bros. & Johnson, 816 Locust St., Wilmington, Del.

BOXES—Lock:
Bethlehem Steel Co., Bethlehem, Pa.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Fischer & Porter Co., Houston, Tex.
Johnston & Jennings Co., The, Cleveland, Ohio
National Aeroil Burner Co., 1230 E. Sedgley Ave., Philadelphia, Pa.

BRASS—Sheet:
American Brass Co., 25 Broadway, New York City
Chase Brass & Copper Co., Waterbury, Conn.
Revere Copper & Brass, Inc., 230 Park Ave., New York City
Scovill Mfg. Co., Waterbury, Conn.

BREAKERS—Viscosity—See PROCESSES, Refinery:

BREATHERS—Tank—See VALVES, Tank Vent:

BRICK—Acidproof:
Chemical Construction Corp., 30 Rockefeller Plaza, New York City
General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
Kellogg Co., The M. W., 225 Broadway, New York City
Knight, Maurice A., Akron, Ohio
McLeod & Henry Co., Troy, N. Y.
National Carbon Co., Inc., Cleveland, Ohio
Quigley Co., Inc., 56 W. 45th St., New York City
U. S. Stoneware Co., Akron, Ohio

BRICK—Fire:
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Botfield Refractories Co., 776 S. Swanson St., Philadelphia, Pa.
Furnace Economy Co., 201 N. Wells St., Chicago, Ill.
General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Green, A. P., Fire Brick Co., Mexico, Mo.
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
Illinois Clay Products Co., Joliet, Ill.
Johns-Manville Corp., 22 E. 40th St., New York City
Kellogg Co., The M. W., 225 Broadway, New York City
Laclede Christy Clay Products Co., St. Louis, Mo.
McLeod & Henry Co., Troy, N. Y.
Mexico Refractories Co., Mexico, Mo.
North American Refractories Co., Cleveland, Ohio
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.
Quigley Co., Inc., 56 W. 45th St., New York City
Stein, Jno. G., & Co., Ltd., Bonneybridge, Scotland
U. S. Stoneware Co., Akron, Ohio

BRICK—Fire Plastic:
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Botfield Refractories Co., 776 S. Swanson St., Philadelphia, Pa.
General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Green, A. P., Fire Brick Co., Mexico, Mo.
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
Illinois Clay Products Co., Joliet, Ill.
Johns-Manville Corp., 22 E. 40th St., New York City
Kellogg Co., The M. W., 225 Broadway, New York City
Laclede Christy Clay Products Co., St. Louis, Mo.
McLeod & Henry Co., Troy, N. Y.
Mexico Refractories Co., Mexico, Mo.
North American Refractories Co., Cleveland, Ohio
Plibrico Jointless Firebrick Co., 1800 N Kingsbury, Chicago, Ill.
Quigley Co., Inc., 56 W. 45th St., New York City
Refractory & Insulation Corp., 381 Fourth Ave., New York City
Southern Refractories Co., Fort Payne, Ala.
Sullivan Co., The, Memphis, Tenn.
U. S. Stoneware Co., Akron, Ohio

BRICK—Insulating:
Armstrong Cork Co., Lancaster, Pa.
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Botfield Refractories Co., 776 S. Swanson St., Philadelphia, Pa.
Carborundum Co., Niagara Falls, N. Y.
Furnace Economy Co., 201 N. Wells St., Chicago, Ill.
General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
Illinois Clay Products Co., Joliet, Ill.
Johns-Manville Corp., 22 E. 40th St., New York City
Kellogg Co., The M. W., 225 Broadway, New York City
Laclede Christy Clay Products Co., St. Louis, Mo.
McLeod & Henry Co., Troy, N. Y.
Mexico Refractories Co., Mexico, Mo.
North American Refractories Co., Cleveland, Ohio
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.
Quigley Co., Inc., 56 W. 45th St., New York City
Refractory & Insulation Corp., 381 Fourth Ave., New York City
Schundler, F. E., Co., Joliet, Ill.
Sullivan Co., The, Memphis, Tenn.
U. S. Stoneware Co., Akron, Ohio
Universal Zonolite Insulation Co., 135 La Salle St., Chicago, Ill.

BRICK—Refractory:
Armstrong Cork Co., Lancaster, Pa.
Alberene Stone Corp., 419 Fourth Ave., New York City
Babcock & Wilcox Co., 85 Liberty St., New York City
Carborundum Co., Niagara Falls, N. Y.
Corhart Refractories Co., 16th and Lee Sts., Louisville, Ky.
Custodis Construction Co., Inc., 80 Broad St., New York City
General Refractories Co., Philadelphia, Pa.
Harbison-Walker Refractories Co., Pittsburgh, Pa.
Johns-Manville Corp., 22 E. 40th St., New York City
Mexico Refractories Co., Mexico, Mo.
Norton Co., Worcester, Mass.

BUBBLE CAPS—See CAPS, Bubble:

BUBBLE TRAYS—See TRAYS, Bubble:

BUBBLE TOWERS—See TOWERS, Bubble:

BUILDINGS—Sectional, Steel:
Allied Steel Products Corp., Tulsa, Okla.
Beers Steel Building Corp., 116 Nassau St., New York City
Blaw-Knox Co., Blawnox, Pa.
Braden Steel Corp., Tulsa, Okla.
Butler Mfg. Co., Kansas City, Mo.
Great Lakes Steel Corp., Stran Steel Div., Detroit, Mich.
Mosher Steel Co., Houston, Tex.
Patterson Steel Co., Tulsa, Okla.
Pittsburgh-Des Moines Steel Co., Neville Island P.O., Pittsburgh, Pa.
Standard Steel Corp., Los Angeles, Calif.
Truscon Steel Co., Youngstown, Ohio
Watkins, Inc., Wichita, Kans.

BUILDINGS—Sectional, Wood:
Houston Ready Cut, Houston, Tex.
Monroe Co., The, Colfax, Iowa
Southern Mill & Mfg. Co., Tulsa, Okla.

BURNERS—Combination, Gas, and Oil:
Alcorn Combustion Co., 15th and Race Sts., Philadelphia, Pa.
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Best, W. N., Engineering Co., Inc., 90 West St., New York City
Combustion Equipment Co., Kansas City, Mo.
Coppus Engineering Co., Worcester, Mass.
Engineer Co., 75 West St., New York City
Faber Engineering Co., Westmoreland and Amber Sts., Philadelphia, Pa.
Maxon Premix Burner Co., Muncie, Ind.
National Airoil Burner Co., 1236 E. Sedgley Ave., Philadelphia, Pa.
Parrigin Burners, Dallas, Tex.
Peabody Engineering Corp., 580 Fifth Ave., New York City

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Webster Engr. Co., Div. Surface Combustion Co., Tulsa, Okla.
Zink, John, Co., Tulsa, Okla.

BURNERS—Gas:
Aeroil Burner Co., Inc., 561 Park Ave., West New York, N. J.
Alcorn Combustion Co., 15th and Race Sts., Philadelphia, Pa.
Anchor Burner Co., Oklahoma City, Okla.
Beck Engineering & Combustion Co., St. Louis, Mo.

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Coppus Engineering Co., Worcester, Mass.
Engineer Co., 75 West St., New York City
Faber Engineering Co., Westmoreland and Amber Sts., Philadelphia, Pa.
Forney Engineering Co., Dallas, Tex.
Inferno Co., Shreveport, La.
Maxon Premix Burner Co., Muncie, Ind.
National Airoil Burner Co., 1236 E. Sedgley Ave., Philadelphia, Pa.
National Machine Works, 1559 N. Sheffield, Chicago, Ill.
Natural Gas Equipment, Inc., Los Angeles, Calif.
Oil Well Supply Co., Dallas, Tex.
Parrigin Burners, Dallas, Tex.
Peabody Engineering Corp., 580 Fifth Ave., New York City
Red Devil Burner Co., Houston, Tex.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Sonner Burner Co., The, Winfield, Kans.
Sterling Packing & Gasket Co., Houston, Tex.
Todd Combustion Equipment, Inc., 601 W. 26th St., New York City
Vapor Recovery Systems Co., The, Compton, Calif.
Webster Engr. Co., Div. Surface Combustion Co., Tulsa, Okla.
Zink, John, Co., Tulsa, Okla.

BURNERS—Oil:
Aeroil Burner Co., Inc., 561 Park Ave., West New York, N. J.
Alcorn Combustion Co., 15th and Race Sts., Philadelphia, Pa.
American Steel Works, Kansas City, Mo.
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Best, W. N., Engineering Co., Inc., 90 West St., New York City
Burt Tank, Separator & Oil Treating Corp., Wichita Falls, Tex.
Combustion Equipment Co., Kansas City, Mo.
Engineer Co., 75 West St., New York City
Faber Engineering Co., Westmoreland and Amber Sts., Philadelphia, Pa.
Inferno Co., Shreveport, La.
National Airoil Burner Co., 1236 E. Sedgley Ave., Philadelphia, Pa.
National Supply Co., Toledo, Ohio
Natural Gas Equipment, Inc., Los Angeles, Calif.
Oil Well Supply Co., Dallas, Tex.
Parrigin Burners, Dallas, Tex.
Peabody Engineering Corp., 580 Fifth Ave., New York City
Preferred Utilities Co., Inc., New York City
Red Devil Burner Co., Houston, Tex.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Schutte & Koerting Co., 1116 Thompson St., Philadelphia, Pa.
Todd Combustion Equipment, Inc., 601 W. 26th St., New York City
Webster Engr. Co., Div. Surface Combustion Co., Tulsa, Okla.
Zink, John, Co., Tulsa, Okla.

BURNERS—Powdered Fuel:
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Best, W. N., Engineering Co., Inc., 90 West St., New York City
Combustion Engineering Co., 200 Madison Ave., New York City
Engineer Co., 75 West St., New York City
Foster Wheeler Corp., 165 Broadway, New York City
Peabody Engineering Corp., 580 Fifth Ave., New York City
Whiting Corp., Harvey, Ill.

BURNERS—Sludge:
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Best, W. N., Engineering Co., Inc., 90 West St., New York City
Engineer Co., 75 West St., New York City
National Airoil Burner Co., 1236 E. Sedgley Ave., Philadelphia, Pa.
Peabody Engineering Corp., 580 Fifth Ave., New York City
Todd Combustion Equipment, Inc., 601 W. 26th St., New York City
Webster Engr. Co., Div. Surface Combustion Co., Tulsa, Okla.
Zink, John, Co., Tulsa, Okla.

CABLE—Electrical:
Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
Austin, M. B., Co., 108 S. Desplaines, Chicago, Ill.

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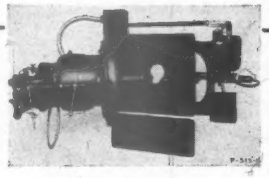
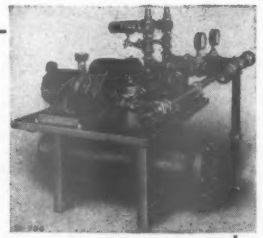
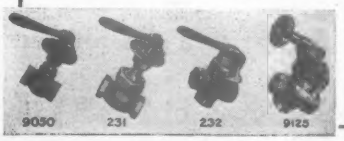
Low Air Pressure Type Oil Burner.


Rotary Oil Burner


Fuel Oil Pumping and Heating Unit.



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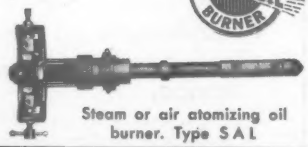
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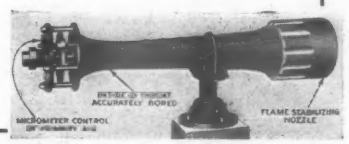
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General Electric Co., Schenectady, N. Y.
Okonite Co., The, Passaic, N. J.
Roebling's, John A., Sons Co., Trenton, N. J.
U. S. Rubber Co., 1230 Sixth Ave., New York City
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Willard Storage Battery Co., E. 131st St. and St. Clair Ave., Cleveland, Ohio

CALIPERS:
Airetool Mfg. Co., Springfield, Ohio
Brown & Sharpe Mfg. Co., Providence, R. I.
Lufkin Rule Co., Hess St., Saginaw, Mich.

CALORIMETERS:
American Meter Co., 60 East 42nd St., New York City
Connelly Iron Sponge & Governor Co., 3154 S. California, Chicago, Ill.
Cutler-Hammer, Inc., Milwaukee, Wis.
Refinery Supply Co., Tulsa, Okla.
Schaar & Co., 754 W. Lexington, Chicago, Ill.

CANS—for MOTOR OILS:
American Can Co., 230 Park Ave., New York City
Continental Can Co., 100 E. 42nd St., New York City
Crown Can Co., Erie Ave. and H St., Philadelphia, Pa.

CAPACITORS:
American Automatic Electric Sales Co., 1033 W. Van Buren, Chicago, Ill.
Cornell Dubilier Electric Corp., South Plainfield, N. J.
General Electric Co., Schenectady, N. Y.
Kellogg Switchboard & Supply Co., 6650 S. Cicero, Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

CAPS—Bubble:
American Locomotive Co., Alco Products Div., 30 Church St., New York City
Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
Badger, E. B., & Sons Co., Boston, Mass.
Beaird Corp., J. B., Shreveport, La.
Biggs Boiler Works, The, Akron, Ohio
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Blickman, S., Inc., Weehawken, N. J.
Braun, C. F., & Co., Inc., Alhambra, Calif.
Continental-Diamond Fibre Co., Bridgeport, Pa.
Devine, J. P., Mfg. Co., Mount Vernon, Ill.
Duraloy Co., The, Scottdale, Pa.
Fluor Corp., Ltd., Box 7030, Los Angeles, Calif.
Hadfields Limited, London, Eng.
Hudson Engineering Co., Houston, Tex.
Kellogg Co., The M. W., 225 Broadway, New York City
Lenape Hydraulic Pressing & Forging Co., West Chester, Pa.
McKee, Arthur G., & Co., Cleveland, Ohio
National Carbon Co., Inc., Cleveland, Ohio
Ohio Steel Foundry Co., The, Springfield, Ohio
Pressed Steel Co., The, Wilkes-Barre, Pa
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Southwestern Engineering Co., Los Angeles, Calif.
Stearns-Roger Mfg. Co., Denver, Colo.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Watkins, Inc., Wichita, Kans.
Western Iron & Foundry Co., Wichita, Kans.
Wheland Co., The, Chattanooga, Tenn.
Winkler-Koch Engineering Co., Wichita, Kans.

CAPS, Welding—See FITTINGS, Welding:

CASTABLES:
Ampco Metals, Inc., Milwaukee, Wis.
Harbison-Walker Refractories Co., Pittsburgh, Pa.
Johns-Manville Corp., 22 E. 40th St., New York City
Mexico Refractories Co., Mexico, Mo.
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.

CASTINGS—Acid-Resisting:
Allegheny Ludlum Steel Corp., Brackenridge, Pa.
Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
Aluminum Industries, Inc., Cincinnati, Ohio
American Manganese Steel Div., 389 E. 14th St., Chicago Heights, Ill.
Ampco Metals, Inc., Milwaukee, Wis.
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Bethlehem Steel Co., Bethlehem, Pa.
Blaw-Knox Co., Blawnox, Pa.
Bunting Brass & Bronze Co., Toledo, Ohio
Burgess-Parr Co., Freeport, Ill.
Carnegie-Illinois Steel Corp., 434 Fifth Ave., Pittsburgh, Pa.
Cast Iron Pipe Research Assn., 122 S. Michigan, Chicago, Ill.
Chain Belt Co., Milwaukee, Wis.
Copper Alloy Foundry Co., The, Elizabeth, N. J.
Duraloy Co., The, Scottdale, Pa.
Duriron Co., The, Inc., Dayton, Ohio
Farrel-Birmingham Co., Inc., Buffalo, N. Y.
Goslin Birmingham Mfg. Co., Inc., 350 Madison Ave., New York City
Hadfields Limited, London, Eng.
Haynes Stellite Co., Kokomo, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio
Lebanon Steel Foundry, Lebanon, Pa.
Link-Belt Co., 220 S. Belmont Ave., Indianapolis, Ind.
Meehanite Metals Corp., 311 Ross St., Pittsburgh, Pa.
Michiana Products Corp., Michigan City, Ind.
Ohio Steel Foundry Co., The, Springfield, Ohio
Shenango-Penn Mold Co., Dover, Ohio
Sivyer Steel Casting Co., Milwaukee, Wis
Weber Engine Works, Kansas City, Mo.
Wheatley Brothers, Tulsa, Okla.

CASTINGS—Alloy Steel:
American Manganese Steel Div., 389 E. 14th St., Chicago Heights, Ill.
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Bethlehem Steel Co., Bethlehem, Pa.
Blaw-Knox Co., Blawnox, Pa.
Calorizing Co., The, Wilkinsburg Sta., Pittsburgh, Pa.
Carnegie-Illinois Steel Corp., 434 Fifth Ave., Pittsburgh, Pa.
Cooper Alloy Foundry Co., Hillside, N. J.
Copper Alloy Foundry Co., The, Elizabeth, N. J.
Driver Harris Co., Harrison, N. J.
Duraloy Co., The, Scottdale, Pa.
Duriron Co., The, Inc., Dayton, Ohio
Falk Corp., Milwaukee, Wis.
Goslin Birmingham Mfg. Co., Inc., 350 Madison Ave., New York City
Hadfields Limited, London, Eng.
Haynes Stellite Co., Kokomo, Ind.
Key Co., East St. Louis, Ill.
Lebanon Steel Foundry, Lebanon, Pa.
Michiana Products Corp., Michigan City, Ind.
Ohio Steel Foundry Co., The, Springfield, Ohio
Oklahoma Steel Castings Co., Tulsa, Okla.
Reading Steel Casting Div. of American Chain & Cable Co., Inc., Reading, Pa.
Ross-Meehan Foundries, Chattanooga, Tenn.
St. Louis Steel Casting Co., St. Louis, Mo.

CASTINGS—Brass or Bronze:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ampco Metals, Inc., Milwaukee, Wis.
Beryllium Corp. of Pa., Reading, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Bunting Brass & Bronze Co., Toledo, Ohio
Burndy Engineering Co., Inc., 459 E. 133 St., New Yory City
Chance, A. B., Co., The, Centralia, Mo.
Chase Brass & Copper Co., Waterbury, Conn.
Condenser Service & Eng. Co., Inc., Hoboken, N. J.
Federal Mogul Corp., Shoemaker and Lillibridge Sts., Detroit, Mich.
Flagg, Stanley G., & Co., 1421 Chestnut St., Philadelphia, Pa.
Gilbert Brass Foundry Co., St. Louis, Mo.
Jeffrey Mfg. Co., The, Columbus, Ohio
Koppers Co., Koppers Bldg., Pittsburgh, Pa.
Link-Belt Co., 220 S. Belmont Ave., Indianapolis, Ind.
Manistee Iron Works, Manistee, Mich.
Morrison Brothers, Dubuque, Iowa
Progressive Brass Mfg. Co., Tulsa, Okla.
Scovill Mfg. Co., Waterbury, Conn.
Shenango-Penn Mold Co., Dover, Ohio
Wheatley Brothers, Tulsa, Okla.

CASTINGS—Gray Iron and Semisteel:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Car & Foundry Co., 30 Church St., New York City
American Cast Iron Pipe Co., Birmingham, Ala.
American Locomotive Co., 30 Church St., New York City
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Bethlehem Steel Co., Bethlehem, Pa.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Busch Sulzer Bros., Diesel Engine, St. Louis, Mo.
Carnegie-Illinois Steel Corp., 434 Fifth Ave., Pittsburgh, Pa.
Cast Iron Pipe Research Assn., 122 S. Michigan Ave., Chicago, Ill.
Chain Belt Co., Milwaukee, Wis.
Chance, A. B., Co., The, Centralia, Mo.
Clow, James B., & Sons, 201 N. Talman, Chicago, Ill.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Farrel-Birmingham Co., Inc., Buffalo, N. Y.
Flagg, Stanley G., & Co., 1421 Chestnut St., Philadelphia, Pa.
Frederick Iron & Steel Co., Frederick, Md.
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HEAT, CORROSION and ABRASION

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Medart Co., St. Louis, Mo.
Murray Iron Works Co., Burlington, Iowa
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Pittsburgh Piping & Equipment Co., 10 43rd St., Pittsburgh, Pa.
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Babcock & Wilcox Co., The, 85 Liberty St., New York City
Bethlehem Steel Co., Bethlehem, Pa.
Blaw-Knox Co., Blawnox, Pa.
Bunting Brass & Bronze Co., Toledo, Ohio
Calorizing Co., The, Wilkinsburg Sta., Pittsburgh, Pa.
Carnegie-Illinois Steel Corp., 434 Fifth Ave., Pittsburgh, Pa.
Chain Belt Co., Milwaukee, Wis.
Driver Harris Co., Harrison, N. J.
Duraloy Co., The, Scottdale, Pa.
Farrel-Birmingham Co., Inc., Buffalo, N. Y.
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Wall-Colmonoy Corp., Buhl Bldg., Detroit, Mich.
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CAST-IRON PIPE—See PIPE, Cast Iron:

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Carborundum Co., Niagara Falls, N. Y.
Davison Chemical Corp., The, Silica Gel Dept., 20 Hopkins Place, Baltimore, Md.
Dicalite Co., The, 120 Wall St., New York City
Filtrol Corp., 634 So. Spring St., Los Angeles, Calif.
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Dow Chemical Co., The, Midland, Mich.
Hooker Electrochemical Co., Niagara Falls, N. Y.
Mathieson Alkali Works, Inc., 60 E. 42nd St., New York City
Michigan Alkali Co., 1117 Ford Bldg., Detroit, Mich.
Monsanto Chemical Co., St. Louis, Mo.
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.
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Solvay Sales Co., 40 Rector St., New York City
Wyandotte Chemicals Corp., Wyandotte, Mich.

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Chemical Construction Corp., 30 Rockefeller Plaza, New York City
Continental-Diamond Fibre Co., Bridgeport, Pa.
General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Haveg Corp., Newark, Del.
Keystone Refractories Corp., 120 Liberty St., New York City
Knight, Maurice A., Akron, Ohio
Lucas, Robert M., Co., 1955 W. 31st St., Chicago, Ill.
National Carbon Co., Inc., Cleveland, Ohio
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.
Quigley Co., Inc., 56 W. 45th St., New York City
Self-Vulcanizing Rubber Co., 605 W. Washington, Chicago, Ill.
Sullivan Co., The, Memphis, Tenn.
U. S. Stoneware Co., Akron, Ohio

CEMENT—Corrosion Resistant:
Atlas Lumnite Cement Co., 135 E. 42nd St., New York City
Barrett Div., The Allied Chemical & Dye Corp., 40 Rector St., New York City
Baldwin-Hill Co., Trenton, N. J.
Haveg Corp., Newark, Del.
Kellogg Co., The M. W., 225 Broadway, New York City
Lucas, Robert M., Co., 1955 W. 31st. St., Chicago, Ill.
National Carbon Co., Inc., Cleveland, Ohio
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.
Self-Vulcanizing Rubber Co., 605 W. Washington, Chicago, Ill.
Tank Seal Products Co., Tulsa, Okla.
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Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
Johns-Manville Corp., 22 E. 40th St., New York City
Keasbey & Mattison Co., Ambler, Pa.
Kellogg Co., The M. W., 225 Broadway, New York City
Laclede Christy Clay Products Co., St. Louis, Mo.
Lucas, Robert M., Co., 1955 W. 31st St., Chicago, Ill.
Mexico Refractories Co., Mexico, Mo.
North American Refractories Co., Cleveland, Ohio
Quigley Co., Inc., 56 W. 45th St., New York City
Refractory & Insulation Corp., 381 Fourth Ave., New York City
Schundler, F. E., Co., Joliet, Ill.
Sullivan Co., The, Memphis, Tenn.
U. S. Stoneware Co., Akron, Ohio

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Baldwin-Hill Co., Trenton, N. J.
Botfield Refractories Co., 776 S. Swanson St., Philadelphia, Pa.
Carborundum Co., Niagara Falls, N. Y.
Carey, Philip, Co., The, Cincinnati, Ohio
Dicalite Co., The, 120 Wall St., New York City
Eagle-Picher Lead Co., The, Cincinnati, Ohio
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Forty Eight Insulations, Inc., North Aurora, Ill.
General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
Johns-Manville Corp., 22 E. 40th St., New York City
Keasbey & Mattison Co., Ambler, Pa.
Kellogg Co., The M. W., 225 Broadway, New York City
Lucas, Robert M., Co., 1955 W. 31st St., Chicago, Ill.
McLeod & Henry Co., Troy, N. Y.
Mexico Refractories, Mexico, Mo.
Mundet Cork Corp., Brooklyn, N. Y.
Owens Corning Fiberglas Corp., Toledo, Ohio
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.
Refractory & Insulation Corp., 381 Fourth Ave., New York City
Ruberoid Co., 500 Fifth Ave., New York City
Schundler, F. E., Co., Joliet, Ill.
Sullivan Co., The, Memphis, Tenn.
U. S. Stoneware Co., Akron, Ohio
Universal Zonolite Insulation Co., 135 S. La Salle, Chicago, Ill.
Union Asbestos & Rubber Co., Cicero, Ill.
Wyodak Chemical Co., 4600 E. 71st St., Cleveland, Ohio

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X-Pando Corp., Long Island City, N. Y.

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Carborundum Co., Niagara Falls, N. Y.
Clarage Fan Co., Kalamazoo, Mich.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
Johns-Manville Corp., 22 E. 40th St., New York City

Kellogg Co., The M. W., 225 Broadway, New York City
Keystone Refractories Corp., 120 Liberty St., New York City
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McLeod & Henry, Troy, N. Y.
Mexico Refractories Co., Mexico, Mo.
North American Refractories Co., Cleveland, Ohio
Norton Co., Worcester, Mass.
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.
Preferred Utilities Co., Inc., New York City
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CENTRIFUGAL BLOWERS—See BLOWERS, Centrifugal:

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National Acme Co., 170 E. 131st St., Cleveland, Ohio
Sharples Corp., 23rd and Westmoreland Sts., Philadelphia, Pa.

CENTRIFUGAL PUMPS—See PUMPS, Centrifugal:

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Greiner, Emil, Co., 55 Van Dam St., New York City
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Walker, W. L., Co., Tulsa, Okla.

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Union Chain & Mfg., The, Sandusky, Ohio
Whitney Chain & Manufacturing Co., Hartford, Conn.

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Baldwin-Duckworth Div., Springfield, Mass.
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Diamond Chain & Mfg. Co., Indianapolis, Ind.
Emsco Derrick & Equnipment Co., Los Angeles, Calif.
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Link-Belt Co., 220 So. Belmont Ave., Indianapolis, Ind.
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Oil Well Supply Co., Dallas, Tex.
Union Chain & Mfg. Co., The, Sandusky, Ohio
Whitney Chain & Manufacturing Co., Hartford, Conn.

CHAIN HOISTS—See HOISTS, Chain:

CHARTS—Recording:
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Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Minneapolis-Honeywell Regulator Co., Wayne and Windrum Aves., Philadelphia, Pa.
Foxboro Co., The, Foxboro, Mass.
Neumann Brothers, 150 Lafayette, New York City

CHILLERS, Oil — See CHILLING MACHINES

CHEMICAL-MIXING EQUIPMENT — See MIXERS:

CHEMICAL-CONTROL EQUIPMENT:
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Elgin Softener Corp., Elgin, Ill.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Greiner, Emil, Co., 55 Van Dam St., New York City
Haering, D. W., & Co., 205 W. Wacker Drive, Chicago, Ill.
Jeffrey Mfg. Co., The, Columbus, Ohio
Pfoltz & Bauer, Inc., Empire State Bldg., New York City
%Proportioneers, Inc.%, Providence, R. I.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Wallace & Tiernan Co., Belleville, N. J.

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Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
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Bird-Archer Co., Wrigley Bldg., Chicago, Ill.
Carbide & Carbon Chemicals Corp., 30 E. 42nd St., New York City
Davison Chemical Co., Baltimore, Md.
Diamond Alkali Co., Kippers Bldg., Pittsburgh, Pa.
Dow Chemical Co., The, Midland, Mich.
Du Pont de Nemours, E. I., & Co., Inc., Wilmington, Del.
General Chemical Co., 40 Rector St., New York City
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Hercules Powder Co., Inc., Wilmington, Del.
Hooker Electrochemical Co., Niagara Falls, N. Y.
Innes, Speiden & Co., 117 Liberty St., New York City
Lubri-Gas Laboratories, 221 N. La Salle, Chicago, Ill.
Mathieson Alkali Works, Inc., 60 E. 42nd St., New York City
Michigan Alkali Co., 1117 Ford Bldg., Detroit, Mich.
Molybdenum Corp. of America, Pittsburg, Pa.
Monsanto Chemical Co., St. Louis, Mo.
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.
Pflotz & Bauer, Inc., Empire State Bldg., New York City
Pittsburgh Plate Glass Co., Columbia Chemical Div., Pittsburgh, Pa.
Reilly Tar & Chemical Co., Indianapolis, Ind.
Solvay Sales Corp., 40 Rector St., New York City
Sullivan Co., The, Memphis, Tenn.
Vanderbilt, R. T., Co., Inc., 230 Park Ave., New York City

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American Sand-Banum Co., 9 Rockefeller Plaza, New York City
Bird-Archer Co., Wrigley Bldg., Chicago, Ill.
Consolidated Chemical Industries, Houston, Tex.
Creative Chemical Co., 4618 Friendship Ave., Pittsburgh, Pa.
Dearborn Chemical Co., 310 S. Michigan Ave., Chicago, Ill.
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Elgin Softener Corp., Elgin, Ill.
Feedwaters, Inc., 140 Cedar St., New York City
General Chemical Co., 40 Rector St., New York City
Haering, D. W., & Co., Chicago, Ill.
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Magnus Chemical Co., Garwood, N. J.
Monsanto Chemical Co., St. Louis, Mo.
National Aluminate Corp., 6216 W. 66th Place, Chicago, Ill.
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Philadelphia Quartz Co., 121 S. Third St., Philadelphia, Pa.
Protective Coatings, Inc., Detroit, Mich.
Sullivan Co., The, Memphis, Tenn.

CHEMICALS—Water-Treating:
American Sand-Banum Co., 9 Rockefeller Plaza, New York City
Betz, W. H. and L. D., Frankford, Philadelphia, Pa.
Bird-Archer Co., Wrigley Bldg., Chicago, Ill.
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Elgin Softener Corp., Elgin, Ill.
Feedwaters, Inc., 140 Cedar St., New York City
General Chemical Co., 40 Rector St., New York City
Haering, D. W., & Co., 205 W. Wacker Drive, Chicago, Ill.

Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Horn, A. C., Co., Houston, Tex.
Mathieson Alkali Works, Inc., 60 E. 42nd St., New York City
Monsanto Chemical Co., St. Louis, Mo.
National Aluminate Corp., 6216 W. 66th Place, Chicago, Ill.
Oakite Products, Inc., 22 Thames St., New York City
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.
Pfoltz & Bauer, Inc., Empire State Bldg., New York City
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Pittsburgh Plate Glass Co., Columbia Chemical Div., Pittsburgh, Pa.
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Sullivan Co., The, Memphis, Tenn.
Westvaco Chlorine Products Corp., 135 E. 42nd St., New York City

CHILLING MACHINES:
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Vogt, Henry, Machine Co., Louisville, Ky.
Worthington Pump & Machinery Corp., Harrison, N. J.

CHIMNEYS, Steel—See STACKS, Steel

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Michigan Alkali Co., 1117 Ford Bldg., Detroit, Mich.
Monsanto Chemical Co., St. Louis, Mo.
Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.
Pittsburgh Plate Glass Co., Columbia Chemical Div., Pittsburgh, Pa.
Solvay Sales Co., 40 Rector St., New York City
Westvaco Chlorine Products Corp., 135 E. 42nd St., New York City
Wyandotte Chemicals Corp., Wyandotte, Mich.

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Cutler-Hammer, Inc., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Heinemann Circuit Breaker Co., Trenton, N. J.
Kearney, James R., Corp., St. Louis, Mo.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CLAMPS, Belt—See FASTENERS, Belt:

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Oil Well Supply Co., Dallas, Tex.
Skinner, M. B., Co., South Bend., Ind.
Wheatley Brothers, Tulsa, Okla.

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Gustin-Bacon Mfg. Co., Kansas City, Mo.
National Machine Works, 1559 N. Sheffield, Chicago, Ill.
Skinner, M. B., Co., South Bend, Ind.
Smooth-On Mfg. Co., Jersey City, N. J.
Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.

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Clow, James B., & Sons, 201 N. Talman, Chicago, Ill.
Dresser Mfg. Co., Bradford, Pa.
Gaso Pump & Burner Mfg. Co., Tulsa, Okla.
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Jarecki Mfg. Co., St. Louis, Mo.
Manufactured Specialties Co., 1252 Voskamp St., Pittsburgh, Pa.
National Machine Works, 1559 N. Sheffield, Chicago, Ill.
Skinner, M. B., Co., South Bend, Ind.
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Wheatley Brothers, Tulsa, Okla.
Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.

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Dresser Mfg. Co., Bradford, Pa.
Gaso Pump & Burner Mfg. Co., Tulsa, Okla.
Jarecki Mfg. Co., St. Louis, Mo.
Mueller Co., Decatur, Ill.
National Machine Works, 1559 N. Sheffield, Chicago, Ill.
Pittsburgh Valve & Fittings Corp., Barberton, Ohio
Skinner, M. B., Co., South Bend, Ind.
Wheatley Brothers, Tulsa, Okla.

CLAMPS—Weld-Leak:
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Dresser Mfg. Co., Bradford, Pa.
Gaso Pump & Burner Mfg. Co., Tulsa, Okla.
Skinner, M. B., Co., South Bend, Ind.
Wheatley Brothers, Tulsa, Okla.

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Earthen Products, Inc., Houston, Tex.
Filtrol Corp., 634 So. Spring St., Los Angeles, Calif.
Floridin Co., Warren, Pa.
Opper, F. H., Inc., Savannah, Ga.
Research & Development Corp., Wilmington, Del.
Southern Refractories Co., Fort Payne, Ala.

CLAY—Contact:
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Earthen Products, Inc., Houston, Tex.
Filtrol Corp., 634 Spring St., Los Angeles, Calif.
Floridin Co., Warren, Pa.
Illinois Minerals Co., Cairo, Ill.
Miller, Max B., & Co., Inc., 501 Fifth Ave., New York City
Opper, F. H., Inc., Savannah, Ga.
U. S. Stoneware Co., Akron, Ohio

CLAY—Fire:
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Green, A. P., Fire Brick Co., Mexico, Mo.
Harbison-Walker Refractories Co., Pittsburgh, Pa.
Illinois Clay Products Co., Joliet, Ill.
Laclede Christy Clay Products Co., St. Louis, Mo.
Mexico Refractories Co., Mexico, Mo.
North American Refractories Co., Cleveland, Ohio

CLAY TREATING—See PROCESSES, Clay Treating:

CLAYS—Percolating:
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Earthen Products, Inc., Houston, Tex.
Floridin Co., Warren, Pa.
Miller, Max B., & Co., Inc., 501 Fifth Ave., New York City
Opper, F. H., Inc., Savannah, Ga.

CLEANERS—Air—See FILTERS, Air:

CLEANERS—Gas—See SCRUBBERS, Gas:

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Manufacturers Brush Co., 1251 Elmwood Ave., Cleveland, Ohio
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Columbia Alkali Corp., 30 Rockefeller Plaza, New York City
Dearborn Chemical Co., Chicago, Ill.
Diamond Alkali Co., Pittsburgh, Pa.
Homestead Valve Mfg. Co., Coraopolis, Pa., Box 18
Magnus Chemical Co., Garwood, N. J.
Mathieson Alkali Works, Inc., 60 E. 42nd St., New York, N. Y.
Oakite Products, Inc., 22 Thames St., New York City
Philadelphia Quartz Co., 121-129 S. Third St., Philadelphia, Pa.
Pilley Packing & Flue Brush Co., Fort Madison, Iowa
Solvay Sales Corp., 40 Rector St., New York City
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Bristol Co., The, Waterbury, Conn.
Engineering Laboratories, Tulsa, Okla.
Foxboro Co., Foxboro, Mass.
Republic Flow Meters Co., Chicago, Ill.
Standard Electric Time Co., Springfield, Mass.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.

CLOCKS—Stop:
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CLOTH, Filter—See FILTER CLOTH:

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Cambridge Wire Cloth Co., Cambridge, Md.
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Multi-Metal Wire Cloth Co., Inc., 1350 Garrison Ave., Bronx, New York City
Newark Wire Cloth Co., Newark, N. J.
Roebling's, John A., Sons Co., Trenton, N. J.
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Truscon Steel Co., Youngstown, Ohio
Tyler, W. S., Co., 3615 Superior Ave., Cleveland, Ohio
Wickwire Spencer Steel Co., 500 Fifth Ave., New York City

CLOTHING—Asbestos:
Asbestos & Engineering Products, Ltd., London, Eng.
Boyer-Campbell Co., 6540 St. Antoine St., Detroit, Mich.
Davis Emergency Equipment Co., Inc., Newark, N. J.
Ehret Magnesia Manufacturing Co., Valley Forge, Pa.
Industrial Products Co., 2828 N. Fourth St., Philadelphia, Pa.
Johns-Manville Corp., 22 E. 40th St., New York City
Keasbey & Mattison Co., Ambler, Pa.
Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh, Pa.
Pulmosan Safety Equipment Co., Brooklyn, N. Y.
Strauss Co., 925 Liberty Ave., Pittsburgh, Pa.

COAL PULVERIZERS—See PULVERIZERS, Coal:

COATINGS — High-Temperature — See INSULATION:

COATINGS — Pipe — See PROTECTIVE COATINGS, Pipe:

COATINGS—Protective, Furnace:
Acme White Lead & Color Works, 8250 St. Aubin, Detroit, Mich.
Arco Co., 7301 Bessemer Ave., Cleveland, Ohio
Dearborn Chemical Co., 310 S. Michigan Ave., Chicago, Ill.
Eagle-Picher Lead Co., The, Cincinnati, Ohio
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Horn, A. C., Co., Houston, Tex.
Johns-Manville Corp., 22 E. 40th St., New York City
Lucas, Robert M., Co., 1955 W. 31st. St., Chicago, Ill.
National Engineering Products, Inc., 4100 Georgia Ave., Washington, D. C.
Protective Coatings, Inc., Detroit, Mich.
Quigley Co., Inc., 56 W. 45th St., New York City
Tnemec Co., Inc., Kansas City, Mo.
U. S. Stoneware Co., Akron, Ohio

COATINGS—Protective, Tank-Interior—See PROTECTIVE COATINGS, Tank-Interior:

COCKS—Gauge:
Belfield, H., Co., Philadelphia, Pa.
Bristol Co., The, Waterbury, Conn.
Crosby Steam Gage & Valve Co., 165 Broadway, New York City
Detroit Brass & Malleable Works, 100 S. Campbell Ave., Detroit, Mich.
Gato Valve Co., 1430 Oliver Bldg., Pittsburg, Pa.
Inferno Co., Shreveport, La.
Jerguson Gage & Valve Co., Somerville, Mass
Klinger, Richard, Ltd., Sidcup (Kent), England
Lonergan, J. E., Co., Philadelphia, Pa.
Lunkenheimer Co., The, Cincinnati, Ohio
Marsh, Jas. P., Corp., 2073 Southport, Chicago, Ill.
Merco Nordstrom Valve Co., Pittsburgh, Pa.
Newman, Hender & Co., Ltd., Woodchester., Glos., England
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich.
Powell, Wm., Co., The, Cincinnati, Ohio
Swift Lubricator Co., Elmira, N. Y.
Trerice, H. O., Co., Detroit, Mich.
Wright Austin Co., Detroit, Mich.

COCKS—Plug—See VALVES, Plug:

COCKS—Stop, Brass:
Belfield, H., Co., Philadelphia, Pa.
Chase Brass & Copper Co., Waterbury, Conn.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Detroit Brass & Malleable Works, 100 S. Campbell Ave., Detroit, Mich.
Jarecki Mfg. Co., St. Louis, Mo.
Lunkenheimer Co., The, Cincinnati, Ohio
Merco Nordstrom Valve Co., 400 Lexington Ave., Pittsburgh, Pa.
Mueller Co., Decatur, Ill.
National Airoil Burner Co., 1236 E. Sedgley Ave., Philadelphia, Pa.
Newman, Hender & Co., Ltd., Woodchester, Glos., England
Walworth Co., 60 E. 42nd St., New York City

COCKS—Stop, C. I.:
Belfield, H., Co., Philadelphia, Pa.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Detroit Brass & Malleable Works, 100 S. Campbell Ave., Detroit, Mich.
Jarecki Mfg. Co., St. Louis, Mo.
Merco Nordstrom Valve Co., 400 Lexington Ave., Pittsburgh, Pa.
Mueller Co., Decatur, Ill.
National Airoil Burner Co., 1236 E. Sedgley Ave., Philadelphia, Pa.
Newman, Hender & Co., Ltd., Woodchester, Glos., England
Oil Well Supply Co., Dallas, Tex.
Pittsburgh Valve & Fittings Corp., Barberton, Ohio
Reading-Pratt & Cady Div. of the American Chain & Cable Co., Inc., Reading, Pa.
Walworth Co., 60 E. 42nd St., New York City

COCKS—Stop, Steel:
Hamer Oil Tool Co., Long Beach, Calif.
Klinger, Richard, Ltd., Sidcup (Kent), England
Merco Nordstrom Valve Co., 400 Lexington Ave., Pittsburgh, Pa.
National Airoil Burner Co., 1236 E. Sedgley Ave., Philadelphia, Pa.
Newman, Hender & Co., Ltd., Woodchester, Glos., England.

COILS, Pipe—See PIPE COILS:

COLUMNS—Water, Safety-Alarm:
Coy Co., Jos. A., Inc., Tulsa, Okla.
Hunt Tool Co., Houston, Tex.
Inferno Co., Shreveport, La.
Kieley & Mueller, Inc., North Bergen, N. J.
Lunkenheimer Co., The, Cincinnati, Ohio
Shand & Jurs Co., Berkeley, Calif.
Wright-Austin Co., 315 W. Woodbridge, Detroit, Mich.
Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.

COMPOUNDS—Cleaning — See CLEANING COMPOUNDS:

COMPOUNDS—Pipe-Joint (Refinery):
American-Marietta Co., 43 E. Ohio, Chicago, Ill.
Arco Co., 7301 Bessemer Ave., Cleveland, Ohio
Cantleek Products Corp., Flushing, N. Y.
Crane Packing Co., Chicago, Ill.
Du Pont de Nemours, E. I., & Co., Inc., Wilmington, Del.
Grancell, I. H., 1601 E. Nadeau St., Los Angeles, Calif.

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'BESTOLIFE is a joint sealing and anti-seize compound. Joints, studs and bolts assembled with this compound can be broken out easily when desired.

'BESTOLIFE neither separates, hardens, nor softens under variations of operating conditions. It provides leak-proof joints on pipe lines carrying air, oil, gas, water, steam, ammonia, etc.

Use 'BESTOLIFE in assembling header plugs, valves, pumps, boilers, heat exchangers, tanks, evaporators and other refinery equipment.

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Greene, Tweed & Co., 101 Park Ave., New York City
Horn, A. C., Co., Houston, Tex.
Key Co., East St. Louis, Ill.
McDonald, A. Y., Mfg. Co., Dubuque, Iowa
National Engineering Products, Inc., 4100 Georgia Ave., Washington, D. C.
Quigley Co., Inc., 56 W. 45th St., New York City
Rector Well Equip. Co., Fort Worth, Tex.
Reilly Tar & Chemical Co., Indianapolis, Ind.
Rockwood Sprinkler Co., Worcester, Mass.
Smooth-On Mfg. Co., Jersey City, N. J.
Sullivan Co., The, Memphis, Tenn.
U. S. Stoneware Co., Akron, Ohio
X-Pando Corp., 43-15 36th St., Long Island City, N. Y.

COMPOUNDS—Water-Treating—See CHEMICALS, Water-Treating:

COMPRESSORS—Air:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American-Marsh Pumps, Inc., Battle Creek, Mich.
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Carrier Corp., Syracuse, N. Y.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York City.
Clark Bros Co., Inc., Box 560, Olean, N. Y.
Cooper-Bessemer Corp., The, Mount Vernon, Ohio
Davey Compressor Co., Kent, Ohio
DeLaval Steam Turbine Co., Trenton, N. J.
Fuller Co., Catasauqua, Pa.
Gardner Denver Co., Quincy, Ill.
Harley Sales Co., Tulsa, Okla
Ingersoll-Rand Co., 11 Broadway, New York City
LeRoi Co., Milwaukee, Wis.
Nash Engr. Co., South Norwalk, Conn.
Novo Engine Co., Lansing, Mich.
Quincy Compressor Co., Quincy, Ill.
Roots Connersville Blower Co., Connersville, Ind.
Schramm, Inc., West Chester, Pa.
Spray Engineering Co., Somerville, Mass.
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.
Sullivan Machinery Co., Michigan City, Ind.
Union Steam Pump Co., Battle Creek, Mich.
Westinghouse Air Brake Co., Wilmerding, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

COMPRESSORS—Ammonia:
Carrier Corp., Syracuse, N. Y.
Clark Bros. Co., Inc., Box 560, Olean, N. Y.
Cooper-Bessemer Corp., The, Mount Vernon, Ohio
Frick Co., Waynesboro, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City
Worthington Pump & Machinery Corp., Harrison, N. J.

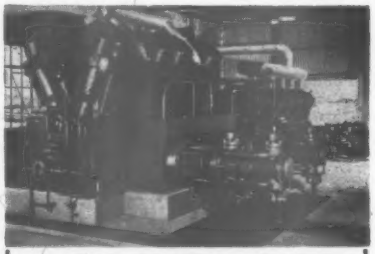
COMPRESSORS—Gas, Angle-Type:
Clark Bros. Co., Inc., Box 560, Olean, N. Y.
Cooper-Bessemer Corp., The, Mount Vernon, Ohio
Ingersoll-Rand Co., 11 Broadway, New York City
Sullivan Machinery Co., Michigan City, Ind.
Worthington Pump & Machinery Corp., Harrison, N. J.

COMPRESSORS—Gas, Belt-Driven:
Beach-Russ Co., 50 Church St., New York City
Bury Compressor Co., Erie, Pa.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York
Clark Bros. Co., Inc., Box 560, Olean, N. Y.
Gardner-Denver Co., Quincy, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.
Union Steam Pump Co., Battle Creek, Mich.
Worthington Pump & Machinery Corp., Harrison, N. J.

COMPRESSORS—Gas, Horizontal Direct-Connected:
Chicago Pneumatic Tool Co., 6 E. 44th St., New York
Clark Bros. Co., Inc., Box 560, Olean, N. Y.
Cooper-Bessemer Corp., The, Mount Vernon, Ohio
Ingersoll-Rand Co., 11 Broadway, New York City
National Transit Pump & Machine Co., Oil City, Pa.
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.
Worthington Pump & Machinery Corp., Harrison, N. J.

COMPRESSORS—Portable:
Beach-Russ Co., 50 Church St., New York City
Binks Mfg. Co., 3124 Carroll Ave., Chicago, Ill.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York City
Clark Bros Co., Inc., Box 560, Olean, N. Y.
Gardner-Denver Co., Quincy, Ill.
Harley Sales Co., Tulsa, Okla.
Ingersoll-Rand Co., 11 Broadway, New York City
LeRoi Co., Milwaukee, Wis.
Schramm, Inc., West Chester, Pa.
Sullivan Machinery Co., Michigan City, Ind.
Westinghouse Air Brake Co., Wilmerding, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

COMPRESSORS—Steam-Engine Driven:
American-Marsh Pumps, Inc., Battle Creek, Mich.
Bury Compressor Co., Erie, Pa.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York
Clark Bros. Co., Inc., Box 560, Olean, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York City
National Transit Pump & Machine Co., Oil City, Pa.



I-R 650-hp and 300-hp gas-engine-driven compressors in a Texas recycling plant. Suction to the compressors from the absorbers is 1850 lb. Discharge pressure is 2400 lb.

GAS-POWERED COMPRESSORS
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RECYCLING, REPRESSURING, GASOLINE EXTRACTION, REFINERY SERVICE, PUMPING

The 4-cycle power ends and the many combinations of compressor cylinders on Ingersoll-Rand gas-engine-driven compressors were designed together as coordinated units. They are substantially built and conservatively rated for continuous, full-load service. Six sizes available from 75 to 800 hp.

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PORTABLE COMPRESSORS

A complete line of MOBIL-AIR two-stage, air-cooled portable compressors for pipeline construction, and for maintenance and repair work around the refinery. Sizes range from 60 to 500 cfm and are available as gasoline or oil-engine-driven units. Various styles of mountings also available.

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There is an I-R Rock Drill for every class of work. Jackhamer and sinker drills are recommended for average jobs and wagon-mounted types for deep holes.

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Sturtevant, B. F., Co., Hyde Park, Boston, Mass.
Worthington Pump & Machinery Corp., Harrison, N. J.

CONCENTRATORS — Sulfuric Acid — See PLANTS, Acid-Recovery:

CONDENSERS—Ammonia:
Biggs Boiler Works, The, Akron, Ohio
Blaw-Knox Co., Blawnox, Pa.
Brown Fintube Co., The, Elyria, Ohio
Carrier Corp., Syracuse, N. Y.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Coy Co., Jos. A., Inc., Tulsa, Okla
Engineers & Fabricators, Inc., Houston, Tex.
Frick Co., Waynesboro, Pa.
Lummus Co., 420 Lexington Ave., New York City
National Radiator Co., The, Johnstown, Pa.
Patterson-Kelley Co., Inc., The, East Stroudsburg, Pa.
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Southwestern Engineering Co., Los Angeles, Calif.
Struthers-Wells, Warren, Pa.
Vogt, Henry, Machine Co., Louisville, Ky.
Whitlock Mfg. Co., The, Hartford, Conn.
Worthington Pump & Machinery Corp., Harrison, N. J.

CONDENSERS—Atmospheric:
American Locomotive Co., Alco Products Div., 30 Church St., New York City
American-Marsh Pumps, Inc., Battle Creek, Mich.
Brown Fintube Co., The, Elyria, Ohio
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Coy Co., Jos. A., Inc., Tulsa, Okla
Engineers & Fabricators, Inc., Houston, Tex.
Griscom-Russell Co., The, New York City, N. Y.
Hendrick Mfg. Co., Carbondale, Pa.
Hudson Engineering Co., Houston, Tex.
Lummus Co., 420 Lexington Ave., New York City
National Radiator Co., The, Johnstown, Pa.
Patterson-Kelley Co., Inc., The, East Stroudsburg, Pa.
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Standard Steel Corp., Los Angeles, Calif.
Stearns-Roger Mfg. Co., Denver, Colo.
Struthers-Wells, Warren, Pa.
Tulsa Boiler & Machinery Co., Tulsa, Okla.

Vogt, Henry, Machine Co., Louisville, Ky.
Whitlock Mfg. Co., The, Hartford, Conn.
Young Radiator Co., Racine, Wis.
Zallea Bros. & Johnson, 816 Locust St., Wilmington, Del.

CONDENSER BOXES—See BOXES, Condenser:

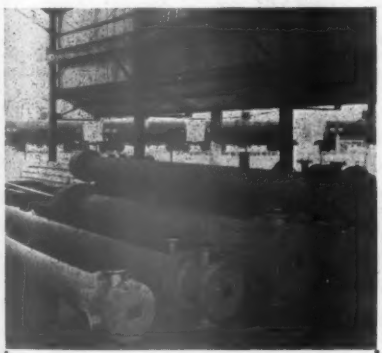
CONDENSER TUBES—See TUBES, Condenser:

CONDENSERS—Barometric:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ampco, Engineering & Construction Co., Dallas, Tex.
Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees, England
Chicago Pneumatic Tool Co., 6 E. 44th St., New York City
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Devine, J. P., Mfg. Co., Mount Vernon, Ill.
Elliott Co., Jeannette, Pa.
Goslin Birmingham Mfg. Co., Inc., 350 Madison Ave., New York City
Ingersoll-Rand Co., 11 Broadway, New York City
Lummus Co., 420 Lexington Ave., New York City
National Radiator Co., The, Johnstown, Pa.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Standard Steel Corp., Los Angeles, Calif.
Struthers-Wells, Warren, Pa.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

CONDENSERS—Fractional:

American Locomotive Co., Alco Products Div., 30 Church St., New York City
Ampco, Engineering & Construction Co., Dallas, Tex.
Bethlehem Steel Co., Bethlehem, Pa.
Biggs Boiler Works, The, Akron, Ohio
Coy Co., Jos. A., Inc., Tulsa, Okla.



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Foster Wheeler Corp., 165 Broadway, New York City
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Hudson Engineering Co., Houston, Tex.
Kellogg Co., The M. W., 225 Broadway, New York City
Leach, C. H. Co., 117 Liberty St., New York City
Lummus Co., 420 Lexington Ave., New York City
Patterson-Kelley Co., Inc., The, East Stroudsburg, Pa.
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Southwestern Engineering Co., Los Angeles, Calif.
Struthers-Wells, Warren, Pa.
Whitlock Mfg. Co., The, Hartford, Conn.

CONDENSERS—Reflux:

American Locomotive Co., Alco Products Div., 30 Church St., New York City
Coy Co., Jos. A., Inc., Tulsa, Okla.
Devine, J. P., Mfg. Co., Inc., Mount Vernon, Ill.
Foster Wheeler Corp., 165 Broadway, New York City
Griscom-Russell Co., The, New York City, N. Y.
Kellogg Co., The M. W., 225 Broadway, New York City
Leach, C. H., Co., Inc., 117 Liberty St., New York City
Lummus Co., The, 420 Lexington Ave., New York City
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Southwestern Engineering Co., Los Angeles, Calif.
Tulsa Boiler & Machinery Co., Tulsa, Okla.

CONDENSERS—Sectional:

American Locomotive Co., Alco Products Div., 30 Church St., New York City
Ampco, Engineering & Construction Co., Dallas, Tex.
Beaird Corp., J. B., Shreveport, La.
Brown Fintube Co., The, Elyria, Ohio
Coy Co., Jos. A., Inc., Tulsa, Okla.
Griscom-Russell Co., The, 285 Madison Ave., New York City
Hudson Engineering Co., Houston, Tex.
Lummus Co., 420 Lexington Ave., New York City
National Radiator Co., The, Johnstown, Pa.
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Southwestern Engineering Co., Los Angeles, Calif.
Whitlock Mfg. Co., The, Hartford, Conn.
Zallea Bros. & Johnson, 816 Locust St., Wilmington, Del.

CONDENSERS—Submerged:

American Locomotive Co., Alco Products Div., 30 Church St., New York City
Ampco, Engineering & Construction Co., Dallas, Tex.
Biggs Boiler Works, The, Akron, Ohio
Coy Co., Jos. A., Inc., Tulsa, Okla.
Engineers & Fabricators, Inc., Houston, Tex.
Griscom-Russell Co., The, 285 Madison Ave., New York City
Hudson Engineering Co., Houston, Tex.
Lummus Co., 420 Lexington Ave., New York City
National Radiator Co., The, Johnstown, Pa.
Patterson-Kelley Co., Inc., The, East Stroudsburg, Pa.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Southwestern Engineering Co., Los Angeles, Calif.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Vogt, Henry, Machine Co., Louisville, Ky.
Whitlock Mfg. Co., The, Hartford, Conn.
Zallea Bros. & Johnson, 816 Locust St., Wilmington, Del.

CONDENSERS—Surface:

American Locomotive Co., Alco Products Div., 30 Church St., New York City
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
Ampco, Engineering & Construction Co., Dallas, Tex.
Biggs Boiler Works, The, Akron, Ohio
Brown Fintube Co., The, Elyria, Ohio
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Croll-Reynolds Engineering Co., 17 John St., New York City
Devine, J. P., Mfg. Co., Mount Vernon, Ill.
Elliott Co., Jeannette, Pa.
Foster Wheeler Corp., 165 Broadway, New York City
Goslin Birmingham Mfg. Co., Inc., 350 Madison Ave., New York City
Hendrick Mfg. Co., Carbondale, Pa.
Hudson Engineering Co., Houston, Tex.
Ingersoll-Rand Co., 11 Broadway, New York City
Kellogg Co., The M. W., 225 Broadway, New York City
Lummus Co., 420 Lexington Ave., New York City
Manistee Iron Works, Manistee, Mich.
National Radiator Co., The, Johnstown, Pa.
Patterson-Kelley Co., Inc., The, East Stroudsburg, Pa.
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Southwestern Engineering Co., Los Angeles, Calif.
Struthers-Wells, Warren, Pa.
Union Steam Pump Co., Battle Creek, Mich.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Whitlock Mfg. Co., The, Hartford, Conn.
Worthington Pump & Machinery Corp., Harrison, N. J.
Young Radiator Co., Racine, Wis.
Zallea Bros. & Johnson, 816 Locust St., Wilmington, Del.

CONDUIT—Steel (Electric Wiring):

Austin, M. B., Co., 108 S. Desplaines, Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Laclede Steel Co., St. Louis, Mo.
Mark, Clayton & Co., Evanston, Ill.
Steel & Tubes Division, Republic Steel Corp., Cleveland, Ohio
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CONSERVATION EQUIPMENT — Vapor—See VAPOR-CONSERVATION EQUIPMENT:

CONSTRUCTION—Natural-Gasoline Plant—See ENGINEERING and CONSTRUCTION, Natural-Gasoline Plant:

CONSTRUCTION — Refinery — See ENGINEERING and CONSTRUCTION, Refinery:

CONTACT FILTRATION EQUIPMENT:
Foster Wheeler Corp., 165 Broadway, New York City
Goslin Birmingham Mfg. Co., Inc., 350 Madison Ave., New York City
U. S. Stoneware Co., Akron, Ohio

CONTROLS—Air-Operated:
American Meter Co., 60 East 42nd St., New York City
Bailey Meter Co., 1038 Ivanhoe Rd., Cleveland, Ohio
Bristol Co., The, Waterbury, Conn.
Brown Instrument Co., Philadelphia, Pa.
Cash, A. W., Co., Decatur, Ill.
Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago, Ill.
Fischer & Porter Co., Hatboro, Pa.
Fisher Governor Co., Marshalltown, Iowa
Foxboro Co., Foxboro, Mass.
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Hanlon-Waters, Inc., Tulsa, Okla.
Kent, George, Ltd., Luton, Bedfordshire, England
Kieley & Mueller, Inc., North Bergen, N. J.
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Leslie Co., Lyndhurst, N. J.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Refinery Supply Co., Tulsa, Okla.
Republic Flow Meters Co., Chicago, Ill.
R-S Products Corp., 110 Berkeley St., Philadelphia, Pa.
Simplex Valve & Meter Co., 68th and Upland Sts., Philadelphia, Pa.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. O., Co., Detroit, Mich.
Webster Engineering Co., Tulsa, Okla.
Westinghouse Air Brake Co., Wilmerding, Pa.

CONTROLS—Automatic:
American Meter Co., 60 East 42nd St., New York City
Automatic Temperature Control Co., 34 E. Logan St., Philadelphia, Pa.
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Cash, A. W., Co., Decatur, Ill.
Cutler-Hammer, Inc., Milwaukee, Wis.
Detroit Lubricator, 5900 Trumbull Ave., Detroit, Mich.
Fischer & Porter Co., Hatboro, Pa.
Fisher Governor Co., Marshalltown, Iowa
Foster Wheeler Corp., 165 Broadway, New York City
Foxboro Co., Foxboro, Mass.
Fulton Sylphon Co., The, Knoxville, Tenn.
Hanlon-Waters, Inc., Tulsa, Okla.
Kent, George, Ltd., Luton, Bedfordshire, England
Kieley & Mueller, Inc., North Bergen, N. J.
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
McDonnell & Miller, Wrigley Bldg., Chicago, Ill.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Moore Products Co., Philadelphia, Pa.
Penn Electric Switch Co., Goshen, Ind.
Republic Flow Meters Co., Chicago, Ill.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Sarco Co., Inc., 475 Fifth Ave., New York City
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. O., Co., Detroit, Mich.
Webster Engineering Co., Tulsa, Okla.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

CONTROLS—Boiler Feed-Water—See REGULATORS, Boiler Feed-Water:

CONTROLS—Draft:
Bailey Meter Co., 1038 Ivanhoe Rd., Cleveland, Ohio
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Cash, A. W., Co., Decatur, Ill.
Foxboro Co., Foxboro, Mass.
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Hays, A. M., Corp., Michigan City, Ind.
Kent, George, Ltd., Luton, Bedfordshire, England
Kieley & Mueller, Inc., North Bergen, N. J.
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Mason Neilan Regular Co., 1190 Adams St., Boston, Mass.
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Republic Flow Meters Co., Chicago, Ill.
Preferred Utilities Co., Inc., New York City
Ruggles Klingemann Mfg. Co., Salem, Mass.
R-S Products Corp., 110 Berkeley St., Philadelphia, Pa.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Webster Engineering Co., Tulsa, Okla.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

CONTROLS—Electric-Motor:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Bradley, Allen, Milwaukee, Wis.
Bristol Co., The, Waterbury, Conn.
Clark Controller Co., 1146 E. 152nd St., Cleveland, Ohio
Cutler-Hammer, Inc., Milwaukee, Wis.
Electric Controller & Mfg. Co., 2698 E. 79th St., Cleveland, Ohio
General Electric Co., Schenectady, N. Y.
Harnischfeger Corp., Milwaukee, Wis.
Ideal Electric & Manufacturing Co., Mansfield, Ohio
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Nelson Electric Mfg. Co., Tulsa, Okla
Penn Electric Switch Co., Goshen, Ind.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Simplex Valve & Meter Co., 68th and Upland Sts., Philadelphia, Pa.
Square D Co., Milwaukee, Wis.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

CONTROLS—Flow:
American Meter Co., 60 East 42nd St., New York City
Bailey Meter Co., 1038 Ivanhoe Rd., Cleveland, Ohio
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Cash, A. W., Co., Decatur, Ill.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Fischer & Porter Co., Hatboro, Pa.
Fisher Governor Co., Marshalltown, Iowa
Foster Wheeler Corp., 165 Broadway, New York City
Foxboro Co., Foxboro, Mass.
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Hanlon-Waters, Inc., Tulsa, Okla.
Kent, George, Ltd., Luton, Bedfordshire, England
Kieley & Mueller, Inc., North Bergen, N. J.
McDonnell & Miller, Wrigley Bldg., Chicago, Ill.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Moore Products Co., Philadelphia, Pa.
Northern Equipment Co., Erie, Pa.
Republic Flow Meters Co., Chicago, Ill.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Simplex Valve & Meter Co., 68th and Upland Sts., Philadelphia, Pa.
Spence Engineering Co., Inc., Walden, N. Y.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester N. Y.
Trerice, H. O., Co., Detroit, Mich.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

CONTROLS—Liquid-Level:
American Meter Co., 60 East 42nd St., New York City
Atlas Valve Co., 276 South St., Newark, N. J.
Automatic Temperature Control Co., 34 E. Logan St., Philadelphia, Pa.
Bailey Meter Co., 1038 Ivanhoe Rd., Cleveland, Ohio
Belfield, H., Co., Philadelphia, Pa.
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Cash, A. W., Co., Decatur, Ill.
Chaplin-Fulton Mfg. Co., 28-40 Penn Ave., Pittsburgh, Pa.
Clark Controller Co., 1146 E. 152nd St., Cleveland, Ohio
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago, Ill.
Fisher Governor Co., Marshalltown, Iowa
Foster Wheeler Corp., 165 Broadway, New York City
Foxboro Co., Foxboro, Mass.
Frick Co., Waynesboro, Pa.
General Electric Co., Schenectady, N. Y.
Griscom-Russell Co., The, 285 Madison Ave., New Work City
Guardian Electric Co., 1623 W. Walnut, Chicago, Ill.
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Hanlon-Waters, Inc., Tulsa, Okla.
Inferno Co., Shreveport, La.
Kent, George, Ltd., Luton, Bedfordshire, England
Kieley & Mueller, Inc., North Bergen, N. J.
McAlear Mfg. Co., 1901 S. Western, Chicago, Ill.
McDonnell & Miller, Wrigley Bldg., Chicago, Ill.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Moore Products Co., Philadelphia, Pa.
Natural Gas Equipment, Inc., Los Angeles, Calif.
Northern Equipment Co., Erie, Pa.
Penn Electric Switch Co., Goshen, Ind.
Republic Flow Meters Co., Chicago, Ill.
Ruggles Klingemann Mfg. Co., Salem, Mass.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Sarco Co., Inc., 475 Fifth Ave., New York City
Simplex Valve & Meter Co., 68th and Upland Sts., Philadelphia, Pa.
Spence Engineering Co., Inc., Walden, N. Y.
Square D Co., Milwaukee, Wis.
Strong, Carlisle & Hamond Co., The, 1392 W. Third St., Cleveland, Ohio
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. O., Co., Detroit, Mich.

Webster Engineering Co., Tulsa, Okla.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

CONTROLS—Motor-Operated:
Automatic Temperature Control Co., 34 E. Logan St., Philadelphia, Pa.
Bailey Meter Co., 1038 Ivanhoe Rd., Cleveland, Ohio
Belfield, H., Co., Philadelphia, Pa.
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Cutler-Hammer, Inc., Milwaukee, Wis.
Foster Wheeler Corp., 165 Broadway, New York City
Foxboro Co., Foxboro, Mass.
General Controls Co., Glendale, Calif.
General Electric Co., Schenectady, N. Y.
Hanlon-Waters, Inc., Tulsa, Okla.
Kieley & Mueller, Inc., North Bergen, N. J.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Ruggles Klingemann Mfg. Co., Salem, Mass.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Simplex Valve & Meter Co., 68th and Upland Sts., Philadelphia, Pa.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Webster Engineering Co., Tulsa, Okla.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

CONTROLS—pH:
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.

CONTROLS—Pressure:
Atlas Valve Co., 276 South St., Newark, N. J.
Belfield, H., Co., Philadelphia, Pa.
Bradley, Allen, Milwaukee, Wis.
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Cash, A. W., Co., Decatur, Ill.
Chaplin-Fulton Mfg. Co., 28-40 Penn Ave., Pittsburgh, Pa.
Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago, Ill.
Fisher Governor Co., Marshalltown, Iowa.
Foster Engineering Co., Newark, N. J.
Foster Wheeler Corp., 165 Broadway, New York City
Foxboro Co., Foxboro, Mass.
Fulton Sylphon Co., The, Knoxville, Tenn.
General Electric Co., Schenectady, N. Y.
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Hanlon-Waters, Inc., Tulsa, Okla.
Inferno Co., Shreveport, La.
Kent, George, Ltd., Luton, Bedfordshire, England
Kieley & Mueller, Inc., North Bergen, N. J.
Leslie Co., Lyndhurst, N. J.
McAlear Mfg. Co., 1901 S. Western, Chicago, Ill.
McDonnell & Miller, Wrigley Bldg., Chicago, Ill.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Moore Products Co., Philadelphia, Pa.
Northern Equipment Co., Erie, Pa.
Penn Electric Switch Co., Goshen, Ind.
Powers Regulator Co., 2720 Greenview Ave., Chicago, Ill.
Republic Flow Meters Co., Chicago, Ill.
Ruggles Klingemann Mfg. Co., Salem, Mass.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Spence Engineering Co., Inc., Walden, N. Y.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. C., Co., Detroit, Mich.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

CONTROLS—Process-Cycle:
Automatic Temperature Control Co., 34 E. Logan St., Philadelphia, Pa.
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Foxboro Co., Foxboro, Mass.
General Electric Co., Schenectady, N. Y.
Hanlon-Waters, Inc., Tulsa, Okla.
Kent, George, Ltd., Luton, Bedfordshire, England
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
National Technical Laboratories, South Pasadena, Calif.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. O., Co., Detroit, Mich.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

CONTROLS—Rate and Volume:
American Meter Co., 60 East 42nd St., New York City
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Cash, A. W., Co., Decatur, Ill.
Fischer & Porter Co., Hatboro, Pa.
Foster Wheeler Corp., 165 Broadway, New York City
Foxboro Co., Foxboro, Mass.
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Republic Flow Meters Co., Chicago, Ill.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Simplex Valve & Meter Co., 68th and Upland Sts., Philadelphia, Pa.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

CONTROLS—Temperature:
Atlas Valve Co., 276 South St., Newark, N. J.
Automatic Temperature Control Co., 34 E. Logan St., Philadelphia, Pa.
Bailey Meter Co., 1038 Ivanhoe Rd., Cleveland, Ohio
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Bradley, Allen, Milwaukee, Wis.
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Cash, A. W., Co., Decatur, Ill.
Detroit Lubricator, 5900 Trumbull Ave., Detroit, Mich.
Eastern Engr. Co., New Haven, Conn.
Englehard, Charles, Inc., Newark, N. J.
Foster Engineering Co., Newark, N. J.
Foster Wheeler Corp., 165 Broadway, New York City
Foxboro Co., Foxboro, Mass.
Fulton Sylphon Co., The, Knoxville, Tenn.
Greiner, Emil, Co., 55 Van Dam St., New York City
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Illinois Engineering Co., 21st and Racine St., Chicago, Ill.
Kent, George, Ltd., Luton, Bedfordshire, England
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
McAlear Mfg. Co., 1901 S. Western, Chicago, Ill.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Penn Electric Switch Co., Goshen, Ind.
Powers Regulator Co., 2720 Greenview Ave., Chicago, Ill.
Reading-Pratt & Cady Div. of the American Chain & Cable Co., Inc., Reading, Pa.
Republic Flow Meters Co., Chicago, Ill.
Ruggles Klingemann Mfg. Co., Salem, Mass.
Sarco Co., Inc., 475 Fifth Ave., New York City

SARCO TEMPERATURE REGULATORS
Complete line thermostatic regulators for temperatures 0° to 400° F. for all types process equipment heated by steam, gas, oil, or cooled by water or brine. Simple, positive, liquid expansion type for close throttling control. Standard pressures to 175 lbs.
Also Sarco TR-40 cooling control for engine, compressor jackets, condensers and Sarco water blender for washrooms, showers, laboratories, process work.
SARCO COMPANY, INC.
475 Fifth Ave., New York, N.Y.

Spence Engineering Co., Inc., Walden, N. Y.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. O., Co., Detroit, Mich.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

CONTROLS—Vacuum:
Bailey Meter Co., 1038 Ivanhoe Rd., Cleveland, Ohio
Bradley, Allen, Milwaukee, Wis.
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Cash, A. W., Co., Decatur, Ill.
Cutler-Hammer, Inc., Milwaukee, Wis.
Fisher Governor Co., Marshalltown, Iowa
Foster Engineering Co., Newark, N. J.
Foxboro Co., Foxboro, Mass.
General Electric Co., Schenectady, N. Y.
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Hanlon-Waters, Inc., Tulsa, Okla.
Kent, George, Ltd., Luton, Bedfordshire, England
Kieley & Mueller, Inc., North Bergen, N. J.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Penn Electric Switch Co., Goshen, Ind.
Republic Flow Meters Co., Chicago, Ill.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Trerice, H. O., Co., Detroit, Mich.
Webster Engineering Co., Tulsa, Okla.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

CONTROLS — Boiler-Fuel — See REGULATORS, Boiler-Fuel:

CONVERTERS—Synchronous:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Pioneer Gen-E-Motor Corp., 466 W. Superior, Chicago, Ill.

CONVEYOR BELTS—See BELTS, Conveyor:

CONSTRUCTION—Natural-Gasoline Plant—See ENGINEERING and CONSTRUCTION, Natural-Gasoline Plant:

CONSTRUCTION — Refinery — See ENGINEERING and CONSTRUCTION, Refinery:

CONTACT FILTRATION EQUIPMENT:
Foster Wheeler Corp., 165 Broadway, New York City
Goslin Birmingham Mfg. Co., Inc., 350 Madison Ave., New York City
U. S. Stoneware Co., Akron, Ohio

CONTROLS—Air-Operated:
American Meter Co., 60 East 42nd St., New York City
Bailey Meter Co., 1038 Ivanhoe Rd., Cleveland, Ohio
Bristol Co., The, Waterbury, Conn.
Brown Instrument Co., Philadelphia, Pa.
Cash, A. W., Co., Decatur, Ill.
Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago, Ill.
Fischer & Porter Co., Hatboro, Pa.
Fisher Governor Co., Marshalltown, Iowa
Foxboro Co., Foxboro, Mass.
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Hanlon-Waters, Inc., Tulsa, Okla.
Kent, George, Ltd., Luton, Bedfordshire, England
Kieley & Mueller, Inc., North Bergen, N. J.
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Leslie Co., Lyndhurst, N. J.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Refinery Supply Co., Tulsa, Okla.
Republic Flow Meters Co., Chicago, Ill.
R-S Products Corp., 110 Berkeley St., Philadelphia, Pa.
Simplex Valve & Meter Co., 68th and Upland Sts., Philadelphia, Pa.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. O., Co., Detroit, Mich.
Webster Engineering Co., Tulsa, Okla.
Westinghouse Air Brake Co., Wilmerding, Pa.

CONTROLS—Automatic:
American Meter Co., 60 East 42nd St., New York City
Automatic Temperature Control Co., 34 E. Logan St., Philadelphia, Pa.
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Cash, A. W., Co., Decatur, Ill.
Cutler-Hammer, Inc., Milwaukee, Wis.
Detroit Lubricator, 5900 Trumbull Ave., Detroit, Mich.
Fischer & Porter Co., Hatboro, Pa.
Fisher Governor Co., Marshalltown, Iowa
Foster Wheeler Corp., 165 Broadway, New York City
Foxboro Co., Foxboro, Mass.
Fulton Syphon Co., The, Knoxville, Tenn.
Hanlon-Waters, Inc., Tulsa, Okla.
Kent, George, Ltd., Luton, Bedfordshire, England
Kieley & Mueller, Inc., North Bergen, N. J.
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
McDonnell & Miller, Wrigley Bldg., Chicago, Ill.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Moore Products Co., Philadelphia, Pa.
Penn Electric Switch Co., Goshen, Ind.
Republic Flow Meters Co., Chicago, Ill.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Sarco Co., Inc., 475 Fifth Ave., New York City
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. O., Co., Detroit, Mich.
Webster Engineering Co., Tulsa, Okla.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

CONTROLS—Boiler Feed-Water—See REGULATORS, Boiler Feed-Water:

CONTROLS—Draft:
Bailey Meter Co., 1038 Ivanhoe Rd., Cleveland, Ohio
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Cash, A. W., Co., Decatur, Ill.
Foxboro Co., Foxboro, Mass.
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Hays, A. M., Corp., Michigan City, Ind.
Kent, George, Ltd., Luton, Bedfordshire, England
Kieley & Mueller, Inc., North Bergen, N. J.
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Mason Neilan Regular Co., 1190 Adams St., Boston, Mass.
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Republic Flow Meters Co., Chicago, Ill.
Preferred Utilities Co., Inc., New York City
Ruggles Klingemann Mfg. Co., Salem, Mass.
R-S Products Corp., 110 Berkeley St., Philadelphia, Pa.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Webster Engineering Co., Tulsa, Okla.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

CONTROLS—Electric-Motor:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Bradley, Allen, Milwaukee, Wis.
Bristol Co., The, Waterbury, Conn.
Clark Controller Co., 1146 E. 152nd St., Cleveland, Ohio
Cutler-Hammer, Inc., Milwaukee, Wis.
Electric Controller & Mfg. Co., 2698 E. 79th St., Cleveland, Ohio
General Electric Co., Schenectady, N. Y.
Harnischfeger Corp., Milwaukee, Wis.
Ideal Electric & Manufacturing Co., Mansfield, Ohio
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Nelson Electric Mfg. Co., Tulsa, Okla
Penn Electric Switch Co., Goshen, Ind.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Simplex Valve & Meter Co., 68th and Upland Sts., Philadelphia, Pa.
Square D Co., Milwaukee, Wis.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

CONTROLS—Flow:
American Meter Co., 60 East 42nd St., New York City
Bailey Meter Co., 1038 Ivanhoe Rd., Cleveland, Ohio
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Cash, A. W., Co., Decatur, Ill.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Fischer & Porter Co., Hatboro, Pa.
Fisher Governor Co., Marshalltown, Iowa
Foster Wheeler Corp., 165 Broadway, New York City
Foxboro Co., Foxboro, Mass.
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Hanlon-Waters, Inc., Tulsa, Okla.
Kent, George, Ltd., Luton, Bedfordshire, England
Kieley & Mueller, Inc., North Bergen, N. J.
McDonnell & Miller, Wrigley Bldg., Chicago, Ill.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Moore Products Co., Philadelphia, Pa.
Northern Equipment Co., Erie, Pa.
Republic Flow Meters Co., Chicago, Ill.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Simplex Valve & Meter Co., 68th and Upland Sts., Philadelphia, Pa.
Spence Engineering Co., Inc., Walden, N. Y.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester N. Y.
Trerice, H. O., Co., Detroit, Mich.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

CONTROLS—Liquid-Level:
American Meter Co., 60 East 42nd St., New York City
Atlas Valve Co., 276 South St., Newark, N. J.
Automatic Temperature Control Co., 34 E. Logan St., Philadelphia, Pa.
Bailey Meter Co., 1038 Ivanhoe Rd., Cleveland, Ohio
Belfield, H., Co., Philadelphia, Pa.
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Cash, A. W., Co., Decatur, Ill.
Chaplin-Fulton Mfg. Co., 28-40 Penn Ave., Pittsburgh, Pa.
Clark Controller Co., 1146 E. 152nd St., Cleveland, Ohio
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago, Ill.
Fisher Governor Co., Marshalltown, Iowa
Foster Wheeler Corp., 165 Broadway, New York City
Foxboro Co., Foxboro, Mass.
Frick Co., Waynesboro, Pa.
General Electric Co., Schenectady, N. Y.
Griscom-Russell Co., The, 285 Madison Ave., New Work City
Guardian Electric Co., 1623 W. Walnut, Chicago, Ill.
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Hanlon-Waters, Inc., Tulsa, Okla.
Inferno Co., Shreveport, La.
Kent, George, Ltd., Luton, Bedfordshire, England
Kieley & Mueller, Inc., North Bergen, N. J.
McAlear Mfg. Co., 1901 S. Western, Chicago, Ill.
McDonnell & Miller, Wrigley Bldg., Chicago, Ill.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Moore Products Co., Philadelphia, Pa.
Natural Gas Equipment, Inc., Los Angeles, Calif.
Northern Equipment Co., Erie, Pa.
Penn Electric Switch Co., Goshen, Ind.
Republic Flow Meters Co., Chicago, Ill.
Ruggles Klingemann Mfg. Co., Salem, Mass.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Sarco Co., Inc., 475 Fifth Ave., New York City
Simplex Valve & Meter Co., 68th and Upland Sts., Philadelphia, Pa.
Spence Engineering Co., Inc., Walden, N. Y.
Square D Co., Milwaukee, Wis.
Strong, Carlisle & Hamond Co., The, 1392 W. Third St., Cleveland, Ohio
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. O., Co., Detroit, Mich.

Webster Engineering Co., Tulsa, Okla.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

CONTROLS—Motor-Operated:
Automatic Temperature Control Co., 34 E. Logan St., Philadelphia, Pa.
Bailey Meter Co., 1038 Ivanhoe Rd., Cleveland, Ohio
Belfield, H., Co., Philadelphia, Pa.
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Cutler-Hammer, Inc., Milwaukee, Wis.
Foster Wheeler Corp., 165 Broadway, New York City
Foxboro Co., Foxboro, Mass.
General Controls Co., Glendale, Calif.
General Electric Co., Schenectady, N. Y.
Hanlon-Waters, Inc., Tulsa, Okla.
Kieley & Mueller, Inc., North Bergen, N. J.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Ruggles Klingemann Mfg. Co., Salem, Mass.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Simplex Valve & Meter Co., 68th and Upland Sts., Philadelphia, Pa.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Webster Engineering Co., Tulsa, Okla.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

CONTROLS—pH:
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.

CONTROLS—Pressure:
Atlas Valve Co., 276 South St., Newark, N. J.
Belfield, H., Co., Philadelphia, Pa.
Bradley, Allen, Milwaukee, Wis.
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Cash, A. W., Co., Decatur, Ill.
Chaplin-Fulton Mfg. Co., 28-40 Penn Ave., Pittsburgh, Pa.
Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago, Ill.
Fisher Governor Co., Marshalltown, Iowa.
Foster Engineering Co., Newark, N. J.
Foster Wheeler Corp., 165 Broadway, New York City
Foxboro Co., Foxboro, Mass.
Fulton Sylphon Co., The, Knoxville, Tenn.
General Electric Co., Schenectady, N. Y.
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Hanlon-Waters, Inc., Tulsa, Okla.
Inferno Co., Shreveport, La.
Kent, George, Ltd., Luton, Bedfordshire, England
Kieley & Mueller, Inc., North Bergen, N. J.
Leslie Co., Lyndhurst, N. J.
McAlear Mfg. Co., 1901 S. Western, Chicago, Ill.
McDonnell & Miller, Wrigley Bldg., Chicago, Ill.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Moore Products Co., Philadelphia, Pa.
Northern Equipment Co., Erie, Pa.
Penn Electric Switch Co., Goshen, Ind.
Powers Regulator Co., 2720 Greenview Ave., Chicago, Ill.
Republic Flow Meters Co., Chicago, Ill.
Ruggles Klingemann Mfg. Co., Salem, Mass.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Spence Engineering Co., Inc., Walden, N. Y.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. C., Co., Detroit, Mich.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

CONTROLS—Process-Cycle:
Automatic Temperature Control Co., 34 E. Logan St., Philadelphia, Pa.
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Foxboro Co., Foxboro, Mass.
General Electric Co., Schenectady, N. Y.
Hanlon-Waters, Inc., Tulsa, Okla.
Kent, George, Ltd., Luton, Bedfordshire, England
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
National Technical Laboratories, South Pasadena, Calif.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. O., Co., Detroit, Mich.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

CONTROLS—Rate and Volume:
American Meter Co., 60 East 42nd St., New York City
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Cash, A. W., Co., Decatur, Ill.
Fischer & Porter Co., Hatboro, Pa.
Foster Wheeler Corp., 165 Broadway, New York City
Foxboro Co., Foxboro, Mass.
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Republic Flow Meters Co., Chicago, Ill.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Simplex Valve & Meter Co., 68th and Upland Sts., Philadelphia, Pa.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

CONTROLS—Temperature:
Atlas Valve Co., 276 South St., Newark, N. J.
Automatic Temperature Control Co., 34 E. Logan St., Philadelphia, Pa.
Bailey Meter Co., 1038 Ivanhoe Rd., Cleveland, Ohio
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Bradley, Allen, Milwaukee, Wis.
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Cash, A. W., Co., Decatur, Ill.
Detroit Lubricator, 5900 Trumbull Ave., Detroit, Mich.
Eastern Engr. Co., New Haven, Conn.
Englehard, Charles, Inc., Newark, N. J.
Foster Engineering Co., Newark, N. J.
Foster Wheeler Corp., 165 Broadway, New York City
Foxboro Co., Foxboro, Mass.
Fulton Sylphon Co., The, Knoxville, Tenn.
Greiner, Emil, Co., 55 Van Dam St., New York City
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Illinois Engineering Co., 21st and Racine St., Chicago, Ill.
Kent, George, Ltd., Luton, Bedfordshire, England
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
McAlear Mfg. Co., 1901 S. Western, Chicago, Ill.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Penn Electric Switch Co., Goshen, Ind.
Powers Regulator Co., 2720 Greenview Ave., Chicago, Ill.
Reading-Pratt & Cady Div. of the American Chain & Cable Co., Inc., Reading, Pa.
Republic Flow Meters Co., Chicago, Ill.
Ruggles Klingemann Mfg. Co., Salem, Mass.
Sarco Co., Inc., 475 Fifth Ave., New York City

SARCO TEMPERATURE REGULATORS
Complete line thermostatic regulators for temperatures 0° to 400° F. for all types process equipment heated by steam, gas, oil, or cooled by water or brine. Simple, positive, liquid expansion type for close throttling control. Standard pressures to 175 lbs.
Also Sarco TR-40 cooling control for engine, compressor jackets, condensers and Sarco water blender for washrooms, showers, laboratories, process work.
SARCO COMPANY, INC.
475 Fifth Ave., New York, N.Y.

Spence Engineering Co., Inc., Walden, N. Y.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. O., Co., Detroit, Mich.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

CONTROLS—Vacuum:
Bailey Meter Co., 1038 Ivanhoe Rd., Cleveland, Ohio
Bradley, Allen, Milwaukee, Wis.
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Cash, A. W., Co., Decatur, Ill.
Cutler-Hammer, Inc., Milwaukee, Wis.
Fisher Governor Co., Marshalltown, Iowa
Foster Engineering Co., Newark, N. J.
Foxboro Co., Foxboro, Mass.
General Electric Co., Schenectady, N. Y.
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Hanlon-Waters, Inc., Tulsa, Okla.
Kent, George, Ltd., Luton, Bedfordshire, England
Kieley & Mueller, Inc., North Bergen, N. J.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Penn Electric Switch Co., Goshen, Ind.
Republic Flow Meters Co., Chicago, Ill.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Trerice, H. O., Co., Detroit, Mich.
Webster Engineering Co., Tulsa, Okla.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

CONTROLS — Boiler-Fuel — See REGULATORS, Boiler-Fuel:

CONVERTERS—Synchronous:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Pioneer Gen-E-Motor Corp., 466 W. Superior, Chicago, Ill.

CONVEYOR BELTS—See BELTS, Conveyor:

CONVEYORS—Portable, Belt:
Chain Belt Co., Milwaukee, Wis.
Jeffrey Mfg. Co., The, Columbus, Ohio
Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia, Pa.
Standard Conveyor Co., St. Paul, Minn.

COOLERS—Air:
American Locomotive Co., Alco Products Div., 30 Church St., New York City
Brown Fintube Co., The, Elyria, Ohio
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Coy Co., Jos. A., Inc., Tulsa, Okla.
Frick Co., Waynesboro, Pa.
Griscom-Russell Co., The, 285 Madison Ave., New York City
Happy Co., The, Tulsa, Okla.
Hudson Engineering Co., Houston, Tex.
National Carbon Co., Inc., Cleveland, Ohio
Oxley Engineering Co., Ltd., London, Eng.
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Standard Steel Corp., Los Angeles, Calif.
Whitlock Mfg. Co., The, Hartford, Conn.
Wyatt Metal & Boiler Works, Houston, Tex.
Young Radiator Co., Racine, Wis.
Zallea Bros. & Johnson, 816 Locust St., Wilmington, Del.

COOLERS—Brine:
Biggs Boiler Works, The, Akron, Ohio
Carrier Corp., Syracuse, N. Y.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Corning Glass Works, Corning, N. Y.
Coy Co., Jos. A., Inc., Tulsa, Okla.
Engineers & Fabricators, Inc., Houston, Tex.
Frick Co., Waynesboro, Pa.
Griscom-Russell Co., The, 285 Madison Ave., New York City
Happy Co., The, Tulsa, Okla.
Hudson Engineering Co., Houston, Tex.
National Carbon Co., Inc., Cleveland, Ohio
National Radiator Co., The, Johnstown, Pa.
Patterson Foundry & Mach. Co., The, East Liverpool, Ohio
Patterson-Kelley Co., Inc., The, East Stroudsburg, Pa.
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Sims Co., The, Erie, Pa.
Stacey Mfg. Co., The, Cincinnati, Ohio
Standard Steel Corp., Los Angeles, Calif.
Struthers-Wells, Warren, Pa.
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.
Vogt, Henry, Machine Co., Louisville, Ky.
Whitlock Mfg. Co., The, Hartford, Conn.
Worthington Pump & Machinery Corp., Harrison, N. J.
Wyatt Metal & Boiler Works, Houston, Tex.
Young Radiator Co., Racine, Wis.
Zallea Bros. & Johnson, 816 Locust St., Wilmington, Del.

COOLERS—Gas:
American Locomotive Co., Alco Products Div., 30 Church St., New York City
Beaird Corp., J. B., Shreveport, La.
Braun, C. F., & Co., Inc., Alhambra, Calif.
Brown Fintube Co., The, Elyria, Ohio
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Corning Glass Works, Corning, N. Y.
Coy Co., Jos. A., Inc., Tulsa, Okla.
Devine, J. P., Mfg. Co., Mount Vernon, Ill.
Engineers & Fabricators, Inc., Houston, Tex.
Foster Wheeler Corp., 165 Broadway, New York City
Frick Co., Waynesboro, Pa.
Griscom-Russell Co., The, 285 Madison Ave., New York City
Happy Co., The, Tulsa, Okla.
Hudson Engineering Co., Houston, Tex.
Marley Co., The, Kansas City, Kans.
National Radiator Co., The, Johnstown, Pa.
Oxley Engineering Co., Ltd., London, Eng.
Patterson-Kelley Co., Inc., The, East Stroudsburg, Pa.
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Stacey Mfg. Co., The, Cincinnati, Ohio
Stearns-Roger Mfg. Co., Denver, Colo.
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Whitlock Mfg. Co., The, Hartford, Conn.
Worthington Pump & Machinery Corp., Harrison, N. J.
Wyatt Metal & Boiler Works, Houston, Tex.
Young Radiator Co., Racine, Wis.

COOLING SECTIONS—See CONDENSERS:

COOLERS—Water:
Carbondale Div. of Worthington Pump & Machinery Corp., Buffalo, N. Y.
Carrier Corp., Syracuse, N. Y.
Frick Co., Waynesboro, Pa.
Griscom-Russell Co., The, New York City
Leach, C. H., Co., Inc., 117 Liberty St., New York City
Lummus Co., The, 420 Lexington Ave., New York City
Marley Co., The, Kansas City, Kans.
Patterson-Kelley Co., Inc., The, East Stroudsburg, Pa.
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Whitlock Mfg. Co., The, Hartford, Conn.
Young Radiator Co., Racine, Wis.

COOLING TOWERS—Atmospheric Type:
Ampco, Engineering & Construction Co., Dallas, Tex.
Binks Mfg. Co., 3124 Carroll Ave., Chicago, Ill.
Braun, C. F., & Co., Inc., Alhambra, Calif.
Fluor Corp., Ltd., Box 7030, Los Angeles, Calif.
Foster Wheeler Corp., 165 Broadway, New York City
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Hudson Engineering Co., Houston, Tex.
Lillie Hoffman Cooling Towers, Inc., St. Louis, Mo.
Marley Co., The, Kansas City, Kans.
Pritchard, J. F., & Co., Kansas City, Mo.
Schubert-Christy Corp., St. Louis, Mo.
Water Cooling Equipment Corp., St. Louis, Mo.

COOLING TOWERS—Forced-Draft:
Binks Mfg. Co., 3124 Carroll Ave., Chicago, Ill.
Fluor Corp., Ltd., Box 7030, Los Angeles, Calif.
Foster Wheeler Corp., 165 Broadway, New York City
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Hudson Engineering Co., Houston, Tex.

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Pritchard, J. F., & Co., Kansas City, Mo.
Schubert-Christy Corp., St. Louis, Mo.
Water Cooling Equipment Corp., St. Louis, Mo.

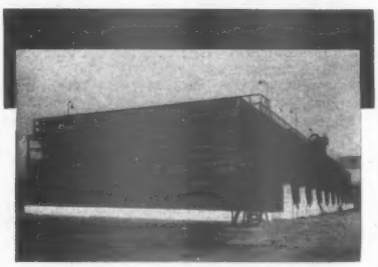
COOLING TOWERS—Induced-Draft:
Binks Mfg. Co., 3124 Carroll Ave., Chicago, Ill.
Fluor Corp., Ltd., Box 7030, Los Angeles, Calif.
Foster Wheeler Corp., 165 Broadway, New York City
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Hudson Engineering Co., Houston, Tex.
Lillie Hoffman Cooling Towers, Inc., St. Louis, Mo.
Marley Co., The, Kansas City, Kans.
Pritchard, J. F., & Co., Kansas City, Mo.
Schubert-Christy Corp., St. Louis, Mo.
Water Cooling Equipment Corp., St. Louis, Mo.

COPPER SWEETENING PROCESSES—See PROCESSES, Copper Sweetening:

COPPER—Sheet:
American Brass Co., 25 Broadway, New York City
Chase Brass & Copper Co., Waterbury, Conn.
Revere Copper & Brass, Inc., 230 Park Ave., New York City

COPPER SULFATE:
Du Pont de Nemours, E. I., & Co., Inc., Wilmington, Del.
Phelps Dodge Refining Corp., 40 Wall St., New York City

COUPLINGS—Air, Steam, and Water-Hose:
Carlyle Rubber Co., 64 Park Place, New York City
Dixon Valve & Coupling Co., Philadelphia, Pa.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodyear Tire & Rubber Co., Akron, Ohio
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Ingersoll-Rand Co., 11 Broadway, New York City



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1137 Hereford Road St. Louis Missouri

Kelly Machinery Co., 2524 W. Madison, Chicago, Ill.
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
Newman, Hender & Co., Ltd., Woodchester, Glos., England
Sterling Packing & Gasket Co., Houston, Tex.
U. S. Rubber Co., 1230 Sixth Ave., New York City
Westinghouse Air Brake Co., Wilmerding, Pa.

COUPLINGS—Metal Hose:
Chicago Metal Hose Corp., Maywood, Ill.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.

COUPLINGS—Shaft, Flange-Type:
American-Marsh Pumps, Inc., Battle Creek, Mich.
Chain Belt Co., Milwaukee, Wis.
Dick, R. and J., Co., Inc., Passaic, N. J.
Dodge Mfg. Co., Mishawaka, Wis.
Falk Corp., Milwaukee, Wis.
Farrel-Birmingham Co., Inc., Buffalo, N. Y.
Foote Brothers Gear & Machine Co., 4545 S. Western, Chicago, Ill
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Jeffrey Mfg. Co., The, Columbus, Ohio
Jones, W. A., Foundry & Machine Co., 4401 W. Roosevelt Rd., Chicago, Ill.
Link-Belt Co., 2410 W. 18th St., Chicago, Ill.
Medart Co., St. Louis, Mo.
Spicer Mfg. Co., Toledo, Ohio
Standard Pressed Steel Co., Stewart & Kenmore Sts., Philadelphia, Pa.
Thomas Flexible Coupling Co., Warren, Pa.
Wood's, T. B., Sons Co., Chambersburg, Pa.

COUPLINGS—Shaft, Flexible:
Ajax Flexible Coupling Co., Westfield, N. Y.
American Flexible Coupling Co., Erie, Pa.
American-Marsh Pumps, Inc., Battle Creek, Mich.
Baldwin-Duckworth Div., Springfield, Mass.
Bartlett-Hayward Division, Coupling Dept., 200 Scott St., Baltimore, Md.
Chain Belt Co., Milwaukee, Wis.
Crocker-Wheeler Electric Mfg. Co., Ampere, N. J.
DeLaval Steam Turbine Co., Trenton, N. J.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Dick, R. and J., Co., Inc., Passaic, N. J.
Excelsior Leather Washer Co., Rockford, Ill.
Falk Corp., Milwaukee, Wis.
Farrel-Birmingham Co., Inc., Buffalo, N. Y.
Foote Brothers Gear & Machine Co., 4545 S. Western, Chicago, Ill.
Frederick Iron & Steel Co., Frederick, Md.
Haveg Corp., Newark, Del.
James, D. O., Mfg. Co., 1114 W. Monroe, Chicago, Ill.
Jeffrey Mfg. Co., The, Columbus, Ohio
Jones, W. A., Foundry & Machine Co., 4401 W. Roosevelt Rd., Chicago, Ill.
Kinney Mfg. Co., 3529-41 Washington St., Boston, Mass.
Koppers Co., Koppers Bldg., Pittsburgh, Pa.
Link-Belt Co., 220 So. Belmont Ave., Indianapolis, Ind.
Lovejoy Flexible Couplings Co., 5036 W. Lake St., Chicago, Ill.
Medart Co., St. Louis, Mo.
Morse Chain Co., Ithaca, N. Y.
Nicholson, W. H., & Co., Wilkes-Barre, Pa.
Poole Foundry & Machine Co., Baltimore, Md.
Spicer Mfg. Co., Toledo, Ohio
Thomas Flexible Coupling Co., Warren, Pa.
Union Chain & Mfg. Co., The, Sandusky, Ohio
Victaulic Co. of America, 30 Rockefeller Plaza, New York City
Waldron, John, Corp., New Brunswick, N. J.
Whitney Chain & Mfg. Co., Hartford, Conn.
Wood's, T. B., Sons Co., Chambersburg, Pa.

COVERING—Pipe—See INSULATION:

COVERS—Gage-Hole—See TANK GAGE and THIEF HATCHES:

CRACKING PROCESSES—See PROCESSES, Refinery:

CROSSES—Forged-Steel:
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Hadfields Limited, London, Eng.
Kerotest Mfg. Co., 2525 Liberty Ave., Pittsburgh, Pa.
Walworth Co., 60 E. 42nd St., New York City
Watson-Stillman Co., Fitting Div., Roselle, N. J.

CROSSES—Drop Forged Steel:
Vogt, Henry, Machine Co., Louisville, Ky.

CROSSES—Pipe, Welding:
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Midwest Piping & Supply Co., St. Louis, Mo.
Taylor Forge & Pipe Works, Chicago, Ill.
Tube Turns, Inc., Louisville, Ky.
Walworth Co., 60 E. 42nd St., New York City
Watson-Stillman Co., Fitting Div., Roselle, N. J.

CUPS—Grease:
Alexander Brothers, Inc., 45 N. Third St., Philadelphia, Pa.
Chase Brass & Copper Co., Waterbury, Conn.
Detroit Lubricator, 5900 Trumbull Ave., Detroit, Mich.
Link-Belt Co., 220 S. Belmont Ave., Indianapolis, Ind.
Lonergan, J. E., Co., Philadelphia, Pa.
Lunkenheimer Co., The, Cincinnati, Ohio
Nathan Mfg. Co., 416 E. 106th St., New York City
Newman, Hender & Co., Ltd., Woodchester, England
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich.
Powell, Wm., Co., The, Cincinnati, Ohio
Swift Lubricator Co., Elmira, N. Y.

CUPS—Oil:
Alexander Brothers, Inc., 405 N. Third St., Philadelphia, Pa.
Chase Brass & Copper Co., Waterbury, Conn.
Corning Glass Works, Corning, N. Y.
Detroit Lubricator, 5900 Trumbull Ave., Detroit, Mich.
Justrite Mfg. Co., 2061 N. Southport Ave., Chicago, Ill.
Lonergan, J. E., Co., Philadelphia, Pa.
Lunkenheimer Co., The, Cincinnati, Ohio
Nathan Mfg. Co., 416 E. 106th St., New York City
Newman, Hender & Co., Ltd., Woodchester, England
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich.
Powell, Wm., Co., The, Cincinnati, Ohio
Swift Lubricator Co., Elmira, N. Y.

CUTTING TORCHES—See WELDING and CUTTING EQUIPMENT:

CUTTERS — Pipe: See THREADERS and CUTTERS:

DAMPERS:
American Manganese Steel Div., 389 E. 14th St., Chicago Heights, Ill.
Green Fuel Economizer Co., Inc., Beacon, N. Y.
Inferno Co., Shreveport, La.

DEAERATORS:
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Croll-Reynolds Engineering Co., 17 John St., New York City
Elliott Co., Jeannette, Pa.
Graver Tank & Mfg. Co., 4809 Todd, East Chicago, Ind.
Standard Steel Corp., Los Angeles, Calif.
Worthington Pump & Machinery Corp., Harrison, N. J.
Wyatt Metal & Boiler Works, Houston, Tex.

DEEP-WELL TURBINE PUMPS — See PUMPS, Turbine, Deep-Well:

DECOKING EQUIPMENT—Hydraulic:
Foster Wheeler Corp., 165 Broadway, New York City
Worthington Pump & Machinery Corp., Harrison, N. J.

DEPHLEGMATORS:
Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees, England
Biggs Boiler Works, The, Akron, Ohio
Blaw-Knox Co., Blawnox, Pa.
Hendrick Mfg. Co., Carbondale, Pa.
Oxley Engineering Co., Ltd., London, Eng.
Patterson-Kelley Co., Inc., The, East Stroudsburg, Pa.
Southwestern Engineering Co., Los Angeles, Calif.
Tulsa Boiler & Machinery Co., Tulsa, Okla.

DESALTING — Crude Oil: See PLANTS, Desalting:

DESUPERHEATERS:
American Locomotive Co., Alco Products Div., 30 Church St., New York City
Atlas Valve Co., 276 South St., Newark, N. J.
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Bailey Meter Co., 1038 Ivanhoe Rd., Cleveland, Ohio
Elliott Co., Jeannette, Pa.
Foster Wheeler Corp., 165 Broadway, New York City
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Northern Equipment Co., Erie, Pa.
Republic Flow Meters Co., Chicago, Ill.
Patterson-Kelley Co., Inc., The, East Stroudsburg, Pa.
Spence Engineering Co., Inc., Walden, N. Y.
Standard Steel Corp., Los Angeles, Calif.
Whitlock Mfg. Co., The, Hartford, Conn.

DETECTORS—Hydrogen Sulfide:
Davis Emergency Equipment Co., Inc., Newark, N. J.

DEWAXING EQUIPMENT—See also PROCESSES, Dewaxing:
Biggs Boiler Works, The, Akron, Ohio
Foster Wheeler Corp., 165 Broadway, New York City
Hendrick Mfg. Co., Carbondale, Pa.
Sharples Corp., 23rd and Westmoreland Sts., Philadelphia, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

DEWAXING PROCESSES—See PROCESSES, Dewaxing:

DIE STOCKS:
Armstrong Bros. Tool Co., 317 N. Francisco, Chicago, Ill.
Beaver Pipe Tools, Inc., Warren, Ohio
Crown Die & Tool Co., Chicago, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Jarecki Mfg. Co., Erie, Pa.
Nye Tool & Machine Works, Chicago, Ill.
Oster Mfg. Co., Cleveland, Ohio
Ridge Tool Co., Elyria, Ohio
Toledo Pipe Threading Machine Co., Toledo, Ohio

DIESEL ENGINES—See ENGINES, Diesel:

DISCS—Wire-Screen for Clay Towers, Etc.:
Michigan Wire Cloth Co., 2095 Howard St., Detroit, Mich.
Multi-Metal Wire Cloth Co., Inc., Bronx Borough, New York City

DISTILLATION UNITS—See PROCESSES, Refinery:

DRUMS—Steel: See BARRELS—Steel:

DUST RECOVERY:
Western Precipitation Co., 1016 W. 9th St., Los Angeles, Calif.

EJECTORS—Air:
Ampco, Engineering & Construction Co., Dallas, Tex.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Croll-Reynolds Engineering Co., 17 John St., New York City
Elliott Co., Jeannette, Pa.
Foster Wheeler Corp., 165 Broadway, New York City
Ingersoll-Rand Co., 11 Broadway, New York City
Nathan Mfg. Co., 416 E. 106th St., New York City
Shand & Jurs Co., Berkeley, Calif.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

EJECTORS—Steam Jet:
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Continental-Diamond Fibre Co., Bridgeport, Pa.
Croll-Reynolds Engineering Co., 17 John St., New York City
Duriron Co., The, Inc., Dayton, Ohio
Elliott Co., Jeannette, Pa.
Foster Wheeler Corp., 165 Broadway, New York City
Haveg Corp., Newark, Del.
Ingersoll-Rand Co., 11 Broadway, New York City

Three-stage I-R ejector with two big boosters and a booster condenser serving a large vacuum distillation unit in an oil refinery.

STEAM-JET EJECTORS

The installation shown was designed to handle 10,000 pounds of steam per hour, plus 200 pounds of air per hour and 100 pounds of oil vapors per hour at 32 mm., Hg., abs. When installed in 1937, these big booster ejectors were believed to be the largest in the world in this kind of service.

Ingersoll-Rand has a complete line of other vacuum equipment for the petroleum, chemical and process industries.

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Ohio Injector Co., Wadsworth, Ohio
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich.
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Schutte & Koesting Co., Philadelphia, Pa.
Sarco Co., Inc., 475 Fifth Ave., New York City
Shand & Jurs Co., Berkeley, Calif.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

ELECTRIC CABLE—See CABLE, Electric:

ELECTRIC CIRCUIT BREAKERS—See CIRCUIT BREAKERS, Electric:

ELETRIC LANTERNS — See LANTERNS, Electric:

ELECTRIC-MOTOR STARTERS — See STARTERS, Electric-Motor:

ELECTRIC SWITCHES — See SWITCHES, Electric:

ELECTRIC WELDING MACHINES — See WELDERS, Electric Arc:

ELECTRODES — Welding: See WELDING RODS and ELECTRODES:

ELECTRODE HOLDERS — See WELDING ELECTRODE HOLDERS:

ELLS—Welding:
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Grinnell Co., Inc., Providence, R. I.
Limbert, George B., Co., 57 Fulton, Chicago, Ill.
Midwest Piping & Supply Co., St. Louis, Mo.
Taylor Forge & Pipe Works, Chicago, Ill.
Tube Turns, Inc., Louisville, Ky.
Walworth Co., 60 E. 42nd St., New York City
Watson-Stillman Co., Fitting Div., Roselle, N. J.

ENGINEERING and CONSTRUCTION—Natural-Gasoline Plant:
Ampco, Engineering & Construction Co., Dallas, Tex.
Born Engr. Co., Tulsa, Okla.
Bechtel McCone-Parsons Corp., Los Angeles, Calif.
Braun & Co., C. F., Alhambra, Calif.
Flour Corp., Ltd., Box 7030, Los Angeles, Calif.
Foster Wheeler Corp., 165 Broadway, New York City
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Hudson Engineering Co., Houston, Tex.
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Mid-Continent Engineering Co., Inc., Dallas, Tex.
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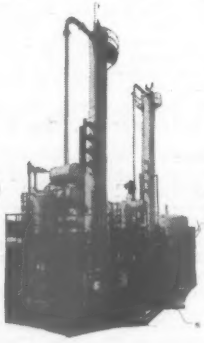

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Gray Processes Corp., 135 E. 42nd St., New York City
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Lummus Co., 1250 Graybar Bldg., New York City
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Smith Engineering Co., Kansas City, Mo.
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Continental Motors Corp., Muskegon Mich.
Cooper-Bessemer Corp., The, Mount Vernon, Ohio
Ingersoll-Rand Co., 11 Broadway, New York City
Minneapolis-Moline Power Implement Co., Minneapolis, Minn.
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Waukesha Motor Co., Waukesha, Wis.
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Buda Co., Harvey, Ill.
Busch Sulzer Bros., Diesel Engine, St. Louis, Mo.
Caterpillar Tractor Co., Peoria, Ill.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York City
Clark Bros. Co., Inc., Box 560, Olean, N. Y.
Cooper-Bessemer Corp., The, Mount Vernon, Ohio
Cummins Engine Co., Columbus, Ind.
Fairbanks, Morse Co., 600 S. Michigan Ave., Chicago, Ill.
General Motors Corp. of the Detroit Diesel Engine Division, Detroit, Mich.
General Motors Corp., Lagrange, Ill.
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Climax Engineering Co., Dallas, Tex.
Continental Motors Corp., Muskegon, Mich.
Domestic Engine & Pump Co., Shippensburg, Pa.
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EXCHANGERS — Heat: See HEAT EXCHANGERS:

EXHAUSTERS and BLOWERS — Manhole: See BLOWERS and EXHAUSTERS, Manhole:

EXHAUST FANS—See FANS, Exhaust:

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Worthington Pump & Machinery Corp., Harrison, N. J.

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Henderer's, A. L., Sons, East Wilmington, Del.
Key Co., East St. Louis, Ill.
Leach, C. H., Co., Inc., 117 Liberty St., New York City
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.

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Knight, Maurice A., Akron, Ohio
Stearns-Roger Mfg. Co., Denver, Colo.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Vulcan Steel Tank Corp., Tulsa, Okla.
Wyatt Metal & Boiler Works, Houston, Tex.

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FABRICATED PIPING — See PREFABRICATED PIPING:

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American Bridge Co., Frick Bldg., Pittsburgh, Pa.
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Beaird Corp., J. B., Shreveport, La.
Bethlehem Steel Co., Bethlehem, Pa.
Biggs Boiler Works, The, Akron, Ohio
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Blaw-Knox Co., Blawnox, Pa.
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
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Hendrick Mfg. Co., Carbondale, Pa.
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Lancaster Iron Works, Lancaster, Pa.
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Lucey Boiler & Mfg. Co., Chattanooga, Tenn.
Maloney Tank Mfg. Co., Tulsa, Okla.
Mosher Steel Co., Houston, Tex.
Muskegon Boiler Works, Muskegon, Mich.
National Radiator Co., The, Johnstown, Pa.
Oxley Engineering Co., Ltd., London, England
Patterson Steel Co., Tulsa, Okla.
Pfaudler Co., The, Rochester, N. Y.
Pittsburgh-Des Moines Steel Co., Newille Island P.O., Pittsburgh, Pa.
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Tulsa Boiler & Machinery Co., Tulsa, Okla.
Vulcan Steel Tank Corp., Tulsa, Okla.
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Wyatt Metal & Boiler Works, Houston, Tex.
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Butane Equipment Co., Dallas, Tex.
Carrier Corp., Syracuse, N. Y.
Champion Blower & Forge Co., Lancaster, Pa.
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Green Fuel Economizer Co., Inc., Beacon, N. Y.
Happy Co., The, Tulsa, Okla.
Ilg Electric Ventilating Co., Chicago, Ill.
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Sims Co., The, Erie, Pa.

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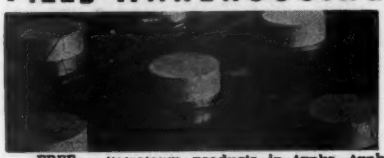

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Fram Corp., Pawtucket Ave., East Providence, R. I.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Goslin Birmingham Mfg. Co., Inc., 350 Madison Ave., New York City
Hilliard Corp., The, Elmira, N. Y.
Honan Crane Corp., 702 Indianapolis Ave., Lebanon, Ind.
Kraissl Co., Inc., The, Hackensack, N. J.
Luber-Finer, Inc., Los Angeles, Calif.
Michiana Products Corp., Michigan City, Ind.
Nugent, Wm. W., Co., 410 N. Hermitage, Chicago, Ill.
Oliver United Filters, Inc., 33 W. 42nd St., New York City
Perry Equipment Co., Dallas, Tex.
Purolator Products, Inc., Newark, N. J.
Shiver, T., & Co., Harrison, N. J.
Sims Co., The, Erie, Pa.
Skinner Purifiers, Inc., 1349 E. Milwaukee, Detroit, Mich.
Sparkler Mfg. Co., Chicago, Ill.
Sperry, D. R., & Co., Batavia, Ill.
Staynew Filter Corp., Rochester, N. Y.
Youngstown Miller Co., Sandusky, Ohio

FILTERS—Pressure:
Alsop Engineering Co., Milldale, Conn.
Biggs Boiler Works, The, Akron, Ohio
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Goslin Birmingham Mfg. Co., Inc., 350 Madison Ave., New York City
Graver Tank & Mfg. Co., 4809 Todd, East Chicago, Ind.
Oliver United Filters, Inc., 33 W. 42nd St., New York City
Shiver, T., & Co., Harrison, N. J.
Sparkler Mfg. Co., Chicago, Ill.
Worthington Pump & Machinery Corp., Harrison, N. J.

FILTERS—Vacuum:
Goslin Birmingham Mfg. Co., Inc., 350 Madison Ave., New York City
Haveg Corp., 919 N. Michigan, Chicago, Ill.
McNamar Boiler & Tank Co., Tulsa, Okla.
Nugent, Wm. W., Co., 410 N. Hermitage, Chicago, Ill.
Oliver United Filters, Inc., 33 W. 42nd St., New York City
Skinner Purifiers, Inc., 1349 E. Milwaukee, Detroit, Mich.
Sparkler Mfg. Co., Chicago, Ill.
Staynew Filter Corp., Rochester, N. Y.
Whiting Corp., Harvey, Ill.

FIRE BRICK—See BRICK, Fire:

FIRE EXTINGUISHERS and FIRE-FIGHTING EQUIPMENT:
American La France & Foamite Corp., Elmira, N. Y.
American-Marsh Pumps, Inc., Battle Creek, Mich.
Cardox Corp., Chicago, Ill.
C-O-Two Fire Equipment Co., Newark, N. J.
Dugas Engineering Co., Marinette, Wis.
General Detroit Corp., The, 2200 E. Jefferson, Detroit, Mich.
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Kidde, Walter, & Co., 140 Cedar St., New York City
National Foam System, Inc., 1632 Sanson St., Philadelphia, Pa.
Pyrene Mfg. Co., 520 Belmont Ave., Newark, N. J.
Richmond Chemical Co., Tulsa, Okla.
Rockwood Sprinkler Co., Worcester, Mass.
Spray Engineering Co., Somerville, Mass.
Walker, W. L., Co., Tulsa, Okla.

FIRE HYDRANTS—See HYDRANTS, Fire:

FIRST-AID MATERIALS:
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Bullard, E. D., Co., 275 Eighth St., San Francisco, Calif.
Davis Emergency Equipment Co., Inc., Newark, N. J.
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Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh, Pa.

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Flagg, Stanley G., & Co., 1421 Chestnut St., Philadelphia, Pa.
Jarecki Mfg. Co., St. Louis, Mo.
Kennedy Valve Mfg. Co., The, Elmira, N. Y.
Lunkenheimer Co., The, Cincinnati, Ohio
Morrison Brothers, Dubuque, Iowa
Seamlex Co., Inc., 5-19 48th Ave., Long Island City, N. Y.
Walworth Co., 60 E. 42nd St., New York City

FITTINGS—Cast-Iron:
American Cast Iron Pipe Co., Birmingham, Ala.
Belfield, H., Co., Philadelphia, Pa.
Carson Cadillac Corp., Birmingham, Ala.
Cast Iron Pipe Research Assn., 122 S. Michigan Ave., Chicago, Ill.
Central Foundry Co., 386 Fourth Ave., New York City
Clow, James B., & Sons, 201 N. Talman, Chicago, Ill.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Detroit Brass & Malleable Works, 100 S. Campbell Ave., Detroit, Mich.
Dresser Mfg. Co., Bradford, Pa.
Enardo Foundry & Mfg. Co., Tulsa, Okla.
Flagg, Stanley G., & Co., 1421 Chestnut St., Philadelphia, Pa.
Flori Pipe Co., St. Louis, Mo.
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Jarecki Mfg. Co., St. Louis, Mo.
Kennedy Valve & Mfg. Co., The, Elmira, N. Y.
McWane Cast Iron Pipe Co., Birmingham, Ala.
M & H Valve & Fittings Co., Anniston, Ala.
National Machine Works, 1559 N. Sheffield, Chicago, Ill.
Oil Well Supply Co., Dallas, Tex.
Pittsburgh Piping & Equipment Co., 10 43rd St., Pittsburgh, Pa.
Pittsburgh Valve & Fittings Corp., Barberton, Ohio
U. S. Pipe & Foundry Co., Burlington, N. J.
Walworth Co., 60 East 42nd St., New York City
Weber Engine Works, Kansas City, Mo.

FITTINGS—Cast-Steel:
Cooper Alloy Foundry Co., Hillside, N. J.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Duraloy Co., Scottdale, Pa.
Flori Pipe Co., St. Louis, Mo.
Frick Co., Waynesboro, Pa.
Kerotest Mfg. Co., 2525 Liberty Ave., Pittsburgh, Pa.
Key Co., East St. Louis, Ill.
Limbert, George B., Co., 570 Fulton, Chicago, Ill.
Ohio Steel Foundry Co., The, Springfield, Ohio
Oil Well Supply Co., Dallas, Tex.
Pittsburgh Piping & Equipment Co., 10 43rd St., Pittsburgh, Pa.
Security Engineering Co., Inc., Whittier, Calif.
Sivyer Steel Casting Co., Milwaukee, Wis.
Thornhill-Craver Co., Houston, Tex.
Walworth Co., 60 E. 42nd St., New York City
Watson-Stillman Co., Fitting Div., Roselle, N. J.

FITTINGS—Drop Forged Steel:
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FITTINGS—Electric Lighting:
All-Steel-Equip Co., Aurora, Ill.
Appleton Electric Co., 1713 Wellington, Chicago, Ill.
Crouse-Hinds Co., Syracuse, N. Y.
General Electric Co., Schenectady, N. Y.
Pyle National Co., 1334 N. Kostner, Chicago, Ill.
Raco All-Steel Products, Aurora, Ill.

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Bonney Forge & Tool Works, Allentown, Pa.
Catawissa Valve & Fittings Co., Catawissa, Pa.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Dresser Mfg. Co., Bradford, Pa.
Endicott Forging & Mfg. Co., Inc., Endicott, N. Y.
Flori Pipe Co., St. Louis, Mo.
Kerotest Mfg. Co., 2525 Liberty Ave., Pittsburgh, Pa.

Laughlin, Thomas, Co., Portland, Me.
Texas Pipe Bending Co., Houston, Tex.
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Walworth Co., 60 E. 42nd St., New York City
Watson-Stillman Co., Fitting Div., Roselle, N. J.
Whitlock Mfg. Co., Hartford, Conn.
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FITTINGS — Orifice: See ORIFICE FITTINGS:

FITTINGS—Malleable:
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Dresser Mfg. Co., Bradford, Pa.
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Grinnell Co., Inc., Providence, R. I.
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Jarecki Mfg. Co., St. Louis, Mo.
Kennedy Valve & Mfg. Co., The, Elmira, N. Y.
National Carbon Co., Inc., Cleveland, Ohio
Oil Well Supply Co., Dallas, Tex.
Rhode Island Fittings Co., Hillsgrove, R. I.
Thornhill-Craver Co., Houston, Tex.
Victaulic Co. of America, 30 Rockefeller Plaza, New York City
Walworth Co., 60 E. 42nd St., New York City

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FITTINGS—Welding:
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Grinnell Co., Inc., Providence, R. I.
Lenape Hydraulic Pressing & Forging Co., West Chester, Pa.
Limbert, George B., Co., 570 Fulton, Chicago, Ill.
Lincoln Electric Co., 12818 Coit St., Cleveland, Ohio
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Philadelphia Steel & Iron Co., Conshohocken, Pa.
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Texas Pipe Bending Co., Houston, Tex.
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Watson-Stillman Co., Fitting Div., Roselle, N. J.

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Detroit Brass & Malleable Works, 100 S. Crane Co., 836 S. Michigan Ave., Chicago, Ill.
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Grinnell Co., Inc., Providence, R. I.
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FLAME ARRESTORS—See ARRESTORS, Flame:

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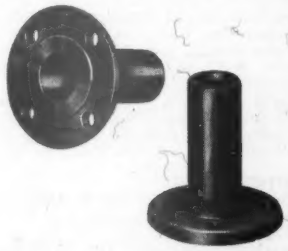

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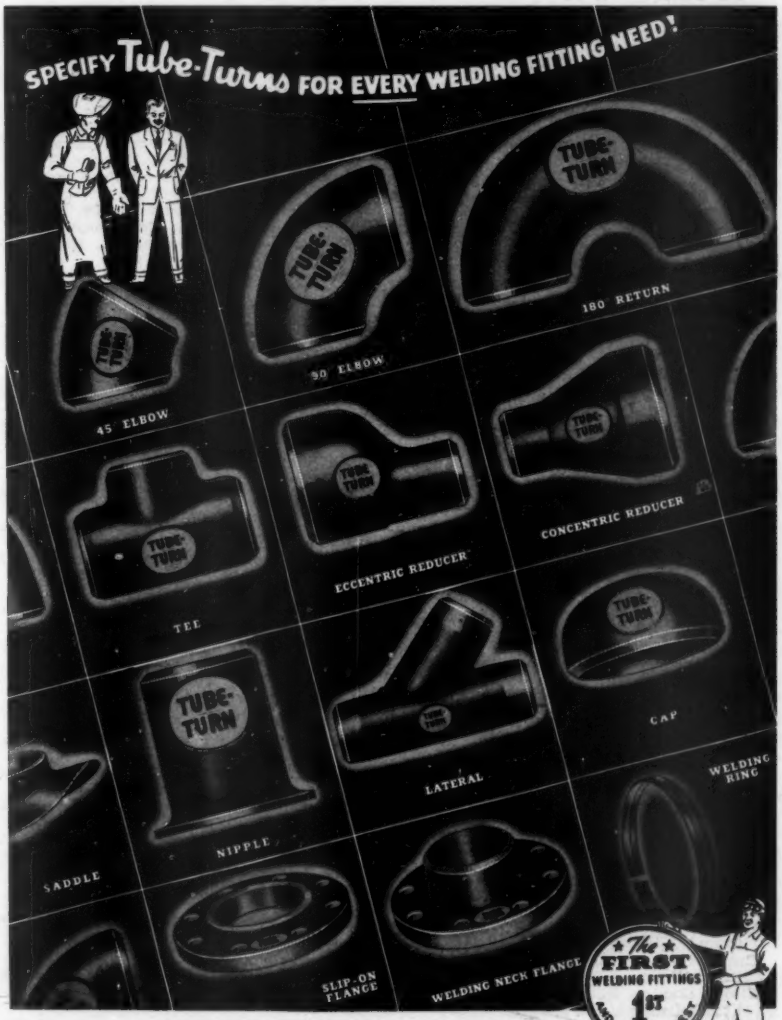

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M & H Valve & Fittings Co., Anniston, Ala.
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Pittsburgh Piping & Equipment Co., 10 43rd St., Pittsburgh, Pa.
Pittsburgh Valve & Fittings Corp., Barberton, Ohio
Powell, Wm., Co., The, Cincinnati, Ohio
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Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Flori Pipe Co., St. Louis, Mo.
Grinnell Co., Inc., Providence, R. I.
Harrisburg Steel Corp., Harrisburg, Pa.
Kerotest Mfg. Co., 2525 Liberty Ave., Pittsburgh, Pa.
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Pittsburgh Piping & Equipment Co., 10 43rd St., Pittsburgh, Pa.
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Gaso Pump & Burner Mfg. Co., Tulsa, Okla.
Grinnell Co., Inc., Providence, R. I.
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Walworth Co., 60 E. 42nd St., New York City

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Daniel Orifice Fitting Co., 3352 Union Pacific Ave., Los Angeles, Calif.
Kropp Forge Co., 5301 W. Roosevelt Rd., Chicago, Ill.
Meriam Co., The, 1955 W. 112th St., Cleveland, Ohio
Pittsburgh Equitable Meter Co., 400 Lexington Ave., Pittsburgh, Pa.
Pittsburgh Piping & Equipment Co., 10 43rd St., Pittsburgh, Pa.
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FLANGES—Welding—See FITTINGS, Welding:

FLEXIBLE BALL JOINTS—See JOINTS, Flexible Ball:

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General Electric Co., Schenectady, N. Y.
Giant Mfg. Co., Council Bluffs, Iowa
Homelite Corp., Port Chester, N. Y.
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FLOOR PLATES—See FLOORING, also GRATING:

FLOORING—Steel, Safety-Tread:
Alan Wood Steel Co., Conshohocken, Pa.
Allied Steel Products Corp., Tulsa, Okla.
American Abrasive Metals Co., Irvington, N. J.
Arrowhead Iron Works, Kansas City, Mo.
Bates, Walter, Co., Inc., Chicago, Ill.
Blaw-Knox Co., Blawnox, Pa.
Carnegie-Illinois Steel Corp., 434 Fifth Ave., Pittsburgh, Pa.
Consolidated Expanded Metal Co., Wheeling, W. Va.
Hendrick Mfg. Co., Carbondale, Pa.
Irving Subway Grating Co., Inc., 50-25 27th St., Long Island City, N. Y.
Kerlow Steel Flooring Co., Jersey City, N. J.
Klemp, Wm. F., Co., 6624 S. Melvina, Chicago, Ill.
Mosher Steel Co., Houston, Tex.
Patterson Steel Co., Tulsa, Okla.
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Snead Floor Armor Co., Jersey City, N. J.
Standard Steel Spring Co., Gary, Ind.
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Wyatt Metal & Boiler Works, Houston, Tex.

FLOW CONTROLLERS—See CONTROLLERS, Flow:

FLOW METERS—See METERS, Flow:

FLOW RECORDERS—See RECORDERS, Flow:

FORGINGS—Nonferrous:
Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
Ampco Metals, Inc., Milwaukee, Wis.
Chase Brass & Copper Co., Waterbury, Conn.
Scovill Mfg. Co., Waterbury, Conn.
Steel Improvement & Forge Co., The, 960 Addison Rd., Cleveland, Ohio
Williams, J. H., & Co., Buffalo, N. Y.

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Atlas Drop Forge Co., Lansing, Mich.
Bethlehem Steel Co., Bethlehem, Pa.
Billings & Spencer Co., Hartford, Conn.
Bonney Forge & Tool Works, Allentown, Pa.
Carnegie-Illinois Steel Corp., 434 Fifth Ave., Pittsburgh, Pa.
Chance, A. B., Co., The, Centralia, Mo.
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Chicago Bridge & Iron Co., 332 S. Michigan Ave., Chicago, Ill.
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General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Hudson Engineering Co., Houston, Tex.
Kellogg Co., The M. W., 225 Broadway, New York City
Lancaster Iron Works, Lancaster, Pa.
Lummus Co., The, 420 Lexington Ave., New York City
McKee, Arthur G., & Co., Cleveland, Ohio
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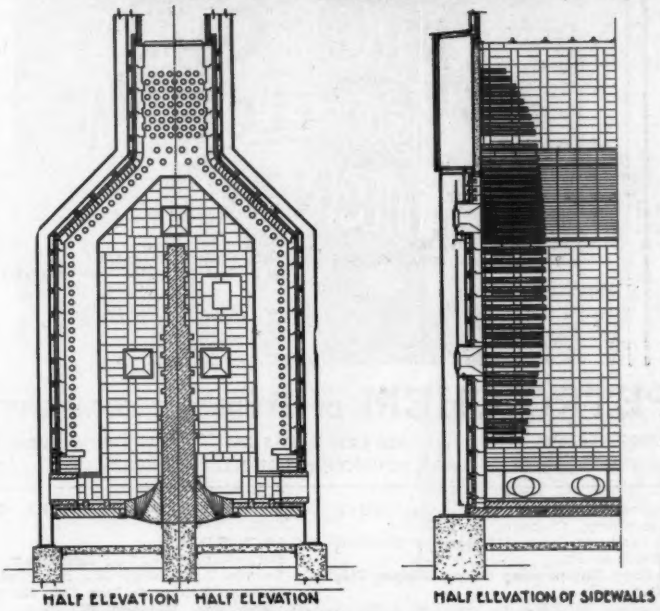

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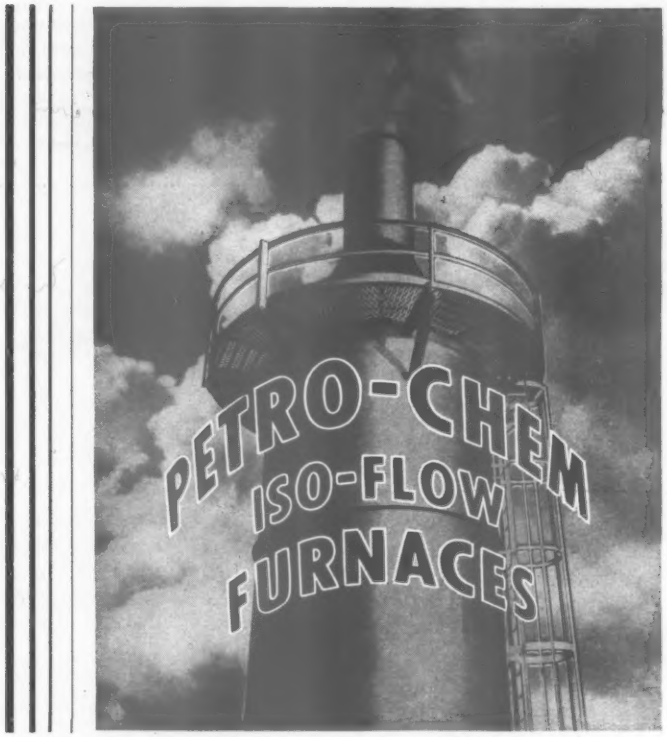
FURNACES—Oil (Continued):
Detrick, M. H., Co., 140 S. Dearborn, Chicago, Ill.
Foster Wheeler Corp., 165 Broadway, New York City
Kellogg Co., The M. W., 225 Broadway, New York City
Lummus Co., The, 420 Lexington, New York City
National Airoil Burner Co., 1236 E. Sedgley Ave., Philadelphia, Pa.
Petro-Chem Development Co., Inc., 120 E. 41st St., New York City
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Weston Electrical Instrument Corp., Newark, N. J.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

GAS COOLERS—See COOLERS, Gas:

GAS BURNERS—See BURNERS, Gas:

GAS COMPRESSORS—See COMPRESSORS:



PETRO-CHEM DEVELOPMENT COMPANY, INC.

REPRESENTATIVES: **120 EAST 41ST STREET** **NEW YORK, N. Y.**

Bethlehem Supply Co., TULSA, HOUSTON, LOS ANGELES Faville-Levally Corp., CHICAGO

Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Stratford Engineering Corp., Kansas City, Mo.

FURNACES—Still:
Alcorn Combustion Co., 15th and Race Sts, Philadelphia, Pa.
Bigelow-Liptak Corp., 2842 W. Grand Blvd., Detroit, Mich.
Braun, C. F., & Co., Alhambra, Calif.
Detrick, M. H., Co., 140 S. Dearborn, Chicago, Ill.
Foster Wheeler Corp., 165 Broadway, New York City
Kellogg Co., The M. W., 225 Broadway, New York City
Lummus Co., The, 420 Lexington, New York City
McKee, Arthur G., & Co., Cleveland, Ohio
Petro-Chem Development Co., Inc., 120 E. 41st St., New York City
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.

FUSIBLE PLUGS—See PLUGS, Fusible:

GALVANOMETERS:
Cambridge Instrument Co., Inc., 3732 Grand Central Terminal, New York City
Engineering Laboratories, Tulsa, Okla.
Foxboro Co., Foxboro, Mass.
General Electric Co., Schenectady, N. Y.

GAS ENGINES—See ENGINES, Gas:

GAS HOLDERS:
Bethlehem Steel Co., Bethlehem, Pa.
Butane Equipment Co., Inc., Dallas, Tex.
Chicago Bridge & Iron Co., 332 S. Michigan Ave., Chicago, Ill.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Graver Tank & Mfg. Co., Inc., East Chicago, Ill.
Koppers Co., Koppers Bldg., Pittsburgh, Pa.
Lancaster Iron Works, Lancaster, Pa.
Oxley Engineering Co., Ltd., London, Eng.
Pittsburgh-Des Moines Steel Co., Neville Island P.O., Pittsburgh, Pa.
Stacey Mfg. Co., The, Cincinnati, Ohio
Stearns-Roger Mfg. Co., Denver, Colo.

GAS METERS—See METERS, Gas:

GAS and OIL BURNERS—See BURNERS:

GAS DEHYDRATION PROCESSES—See PROCESSES, Gas Dehydration:

GAS POLYMERIZATION—See PROCESSES, Refinery:

GAS-PURIFICATION PROCESSES — See PROCESSES, Gas:

GAS REVERSION—See PROCESSES, Refinery:

GASKETS—Asbestos:
Akron Metallic Gasket Co., Akron, Ohio
Asbestos & Engineering Products, Ltd., London, England
Belmont Packing & Rubber Co., Butler & Sepviva, Philadelphia, Pa.
Chicago Wilcox Mfg. Co., 701 S. Avalon, Chicago, Ill.
Darcoid Co., Inc., 149 Sixth Ave., New York City
Durabla Mfg. Co., 114 Liberty St., New York City
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Farnum & Co., F. D., Chicago, Ill.
Felt Products Mfg. Co., Chicago, Ill.
Garlock Packing Co., The, Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodyear Tire & Rubber Co., Akron, Ohio
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Hewitt Rubber Corp., Buffalo, N. Y.
Jenkins Brothers, 80 White St., New York City
Johns-Manville Corp., 22 E. 40th St., New York City
Klinger, Richard, Ltd., Sidcup (Kent), England
Klingerit, Inc., 16 Hudson St., New York City
Linear Packing & Rubber Co., Philadelphia, Pa.
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
Melrath Supply & Gasket Co., Inc., Tioga and Memphis Sts., Philadelphia, Pa.
Metallo Gasket Co., New Brunswick, N. J.
Quaker Rubber Corp., Philadelphia, Pa.
Raybestos-Manhattan, Inc., Manheim, Pa.
Republic Rubber Co., The, Youngstown, Ohio
Russell Mfg. Co., Middletown, Conn.
Standard Asbestos Mfg. & Insulating Co., Kansas City, Mo.
Stevens Asbestos Products Co., Tulsa, Okla.
U. S. Rubber Co., 1230 Sixth Ave., New York City
Vellumoid Co., Worcester, Mass.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

GASKETS—Cork:
Akron Metallic Gasket Co., Akron, Ohio
Armstrong Cork Co., Lancaster, Pa.
Chicago Wilcox Mfg. Co., 7701 S. Avalon, Chicago, Ill.
Darcoid Co., Inc., 149 Sixth Ave., New York City
Felt Products Mfg. Co., Chicago, Ill.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Johns-Manville Corp., 22 E. 40th St., New York City
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Standard Asbestos Mfg. & Insulating Co., Kansas City, Mo.
Stevens Asbestos Products Co., Tulsa, Okla.
Vellumoid Co., Worcester, Mass.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

GASKETS—Corrugated:
Akron Metallic Gasket Co., Akron, Ohio
Azor Corp., Federal Trust Bldg., Newark, N. J.
Chicago Wilcox Mfg. Co., 7701 S. Avalon, Chicago, Ill.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Johns-Manville Corp., 22 E. 40th St., New York City
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Melrath Supply & Gasket Co., Inc., Tioga and Memphis Sts., Philadelphia, Pa.
Metallo Gasket Co., New Brunswick, N. J.
Standard Asbestos Mfg. & Insulating Co., Kansas City, Mo.
Stevens Asbestos Products Co., Tulsa, Okla.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

GASKETS—Fibre:
Akron Metallic Gasket Co., Akron, Ohio
Armstrong Cork Co., Lancaster, Pa.
Chicago Wilcox Mfg. Co., 7701 S. Avalon, Chicago, Ill.
Continental-Diamond Fibre Co., Bridgeport, Pa.
Darcoid Co., Inc., 149 Sixth Ave., New York City
Felt Products Mfg. Co., Chicago, Ill.
Frick Co., Waynesboro, Pa.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Haveg Corp., Newark, Del.
Johns-Manville Corp., 22 E. 40th St., New York City
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Maloney, F. H., Co., Houston, Tex.
Melrath Supply & Gasket Co., Inc., Tioga and Memphis Sts., Philadelphia, Pa.
Metallo Gasket Co., New Brunswick, N. J.
Quaker Rubber Corp., Philadelphia, Pa.
Russell Mfg. Co., Middletown, Conn.
Stevens Asbestos Products Co., Tulsa, Okla.
U. S. Rubber Co., 1230 Sixth Ave., New York City
Vellumoid Co., Worcester, Mass.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

GASKETS—Lead:
Akron Metallic Gasket Co., Akron, Ohio
Chicago Wilcox Mfg. Co., 7701 S. Avalon, Chicago, Ill.
Darcoid Co., Inc., 149 Sixth Ave., New York City
Frick Co., Waynesboro, Pa.
Goetze Gasket & Packing Co., New Brunswick, N. J.
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Metallo Gasket Co., New Brunswick, N. J.
National Lead Co., 111 Broadway, New York City
Stevens Asbestos Products Co., Tulsa, Okla.
U. S. Stoneware Co., Akron, Ohio
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

GASKETS—Leather:
Alexander Brothers, Inc., 405 N. Third St., Philadelphia, Pa.
Auer, C. L. and W. W., Corry, Pa.
Chicago Belting Co., 125 N. Green, Chicago, Ill.
Chicago Wilcox Mfg. Co., 7701 S. Avalon, Chicago, Ill.
Excelsior Leather Washer Co., Rockford, Ill.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Graton & Knight Mfg. Co., Worcester, Mass.
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Houghton, E. F., Co., Third, American and Somerset Sts., Philadelphia, Pa.
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Preston, Horace G., Co., 2581 Beecher St., Detroit, Mich.
Rhoads, J. E., & Sons, 35 N. Sixth St., Philadelphia, Pa.
Schieren, Charles A., Co., 30 Ferry St., New York City
Stevens Asbestos Products Co., Tulsa, Okla.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

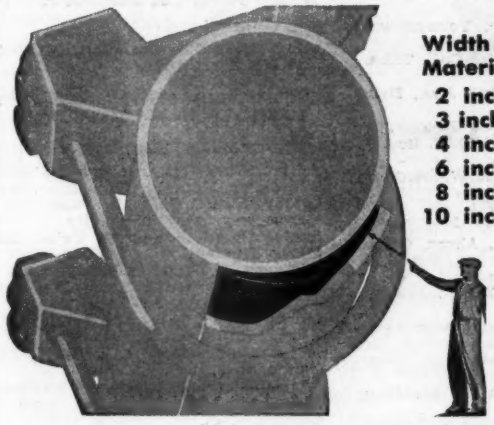
GASKETS—Metallic and Semimetallic:
Akron Metallic Gasket Co., Akron, Ohio
Azor Corp., Federal Trust Bldg., Newark, N. J.
Chase Brass & Copper Co., Waterbury, Conn.
Chicago Wilcox Mfg. Co., 7701 S. Avalon, Chicago, Ill.
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Darcoid Co., Inc., 149 Sixth Ave., New York City
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Johns-Manville Corp., 22 E. 40th St., New York City
Kellogg Co., The M. W., 225 Broadway, New York City
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Maloney, F. H., Co., Houston, Tex.
Melrath Supply & Gasket Co., Inc., Tioga and Memphis Sts., Philadelphia, Pa.
Metallo Gasket Co., New Brunswick, N. J.
National Engineering Products, Inc., 4100 Georgia Ave., Washington, D. C.
Quaker Rubber Corp., Philadelphia, Pa.
Raybestos-Manhattan, Inc., Manheim, Pa.
Smooth-On Mfg. Co., Jersey City, N. J.
Standard Asbestos Mfg. & Insulating Co., Kansas City, Mo.
Stevens Asbestos Products Co., Tulsa, Okla.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

GASKETS—Pipe Repair:
Lima Cord Sole & Heel Co., The, Lima, Ohio
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
National Engineering Products, Inc., 4100 Georgia Ave., Washington, D. C.
Nelson Electric Mfg. Co., Tulsa, Okla.
Quaker Rubber Corp., Philadelphia, Pa.
Resistoflex Corp., Belleville, N. J.
Richardson Co., The, Melrose Park, Ill.
U. S. Stoneware Co., Akron, Ohio
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

GASKETS—Ring:
Akron Metallic Gasket Co., Akron, Ohio
Azor Corp., Federal Trust Bldg., Newark, N. J.
Belmont Packing & Rubber Co., Butler & Sepviva, Philadelphia, Pa.
Darcoid Co., Inc., 149 Sixth Ave., New York City
Durabla Mfg. Co., 114 Liberty St., New York City
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.

GRO-CORD PIPE REPAIR GASKET

Repairs leaks quickly, permanently, economically. Lighter than lead gaskets and makes a tighter, more lasting job. Records show GRO-CORD Gaskets have held leaks for several years. Will not deteriorate. Used by most major pipe line companies.



SIZES

Width of Material	Thickness Center	Thickness Edges
2 inch	5/32"	1/16"
3 inch	3/16"	1/16"
4 inch	1/4 "	1/8 "
6 inch	1/4 "	1/8 "
8 inch	5/16"	3/16"
10 inch	3/8 "	7/32"

WRITE for Samples, Prices and Full Details.

GRO-CORD Gasket Material is Made exclusively by

THE LIMA CORD SOLE & HEEL CO.

LIMA, OHIO

GASKETS—Plastic:
Acadia Synthetic Products Div., Western Felt Works, Chicago, Ill.
Cantleek Products Corp., Flushing, N. Y.
Chicago Belting Co., 125 N. Green, Chicago, Ill.
Continental-Diamond Fibre Co., Bridgeport, Pa.
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Darcoid Co., Inc., 149 Sixth Ave., New York City
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Formica Insulation Co., The, Cincinnati, Ohio
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Haveg Corp., Newark, Del.
Johns-Manville Corp., 22 E. 40th St., New York City
Jenkins Brothers, 80 White St., New York City
Johns-Manville Corp., 22 E. 40th St., New York City
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
Melrath Supply & Gasket Co., Inc., Tioga and Memphis Sts., Philadelphia, Pa.
Metallo Gasket Co., New Brunswick, N. J.
Quaker Rubber Corp., Philadelphia, Pa.
Raybestos-Manhattan, Inc., Manheim, Pa.
Standard Asbestos Mfg. & Insulating Co., Kansas City, Mo.
Steel Improvement & Forge Co., The, 960 Addison Rd., Cleveland, Ohio
Stevens Asbestos Products Co., Tulsa, Okla.
Vellumoid Co., Worcester, Mass.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

GASKETS—Rubber:
Akron Metallic Gasket Co., Akron, Ohio
Belmont Packing & Rubber Co., Butler & Sepviva, Philadelphia, Pa.
Carlyle Rubber Co., 64 Park Place, New York City
Chicago Belting Co., 125 N. Green, Chicago, Ill.
Chicago Wilcox Mfg. Co., 7701 S. Avalon, Chicago, Ill.
Cincinnati Rubber Mfg. Co., The, Norwood Sta., Cincinnati, Ohio
Dresser Mfg. Co., Bradford, Pa.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Felt Products Mfg. Co., Chicago, Ill.
Frick Co., Waynesboro, Pa.
Garlock Packing Co., Palmyra, N. Y.
General Tire & Rubber Co., Akron, Ohio
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Hewitt Rubber Corp., Buffalo, N. Y.
Jenkins Brothers, 80 White St., New York City
Johns-Manville Corp., 22 E. 40th St., New York City
Lima Cord Sole & Heel Co., Lima, Ohio
Linear Packing & Rubber Co., Philadelphia, Pa.
Lithox Corp., The, Wapakoneta, Ohio
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Maloney Tank Mfg. Co., Tulsa, Okla.
Manhattan Rubber Mfg. Co., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
Melrath Supply & Gasket Co., Inc., Tioga and Memphis Sts., Philadelphia, Pa.
Quaker Rubber Corp., Philadelphia, Pa.
Raybestos-Manhattan, Inc., Manheim, Pa.
Standard Asbestos Mfg. & Insulating Co., Kansas City, Mo.
Republic Rubber Co., The, Youngstown, Ohio
Stevens Asbestos Products Co., Tulsa, Okla.
U. S. Rubber Co., 1230 Sixth Ave., New York City
U. S. Stoneware Co., Akron, Ohio
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.
Westinghouse Air Brake Co., Wilmerding, Pa.

GASKETS—Sheet:
Akron Metallic Gasket Co., Akron, Ohio
Belmont Packing & Rubber Co., Butler & Sepviva, Philadelphia, Pa.
Chicago Wilcox Mfg. Co., 7701 S. Avalon, Chicago, Ill.
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Darcoid Co., Inc., 149 Sixth Ave., New York City
Durabla Mfg. Co., 114 Liberty St., New York City
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Felt Products Mfg. Co., Chicago, Ill.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Johns-Manville Corp., 22 E. 40th St., New York City
Klingerit, Inc., 16 Hudson St., New York City
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
Melrath Supply & Gasket Co., Inc., Tioga and Memphis Sts., Philadelphia, Pa.
Metallo Gasket Co., New Brunswick, N. J.
Quaker Rubber Corp., Philadelphia, Pa.
Raybestos-Manhattan, Inc., Manheim, Pa.
Republic Rubber Co., The, Youngstown, Ohio
Resistoflex Corp., Belleville, N. J.
Standard Asbestos Mfg. & Insulating Co., Kansas City, Mo.
U. S. Rubber Co., 1230 Sixth Ave., New York City
U. S. Stoneware Co., Akron, Ohio
Vellumoid Co., Worcester, Mass.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

GASKETS—Steel:
Akron Metallic Gasket Co., Akron, Ohio
Azor Corp., Federal Trust Bldg., Newark, N. J.
Chicago Wilcox Mfg. Co., 7701 S. Avalon, Chicago, Ill.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Johns-Manville Corp., 22 E. 40th St., New York City
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Melrath Supply & Gasket Co., Inc., Tioga and Memphis Sts., Philadelphia, Pa.
Metallo Gasket Co., New Brunswick, N. J.
Standard Asbestos Mfg. & Insulating Co., Kansas City, Mo.
Steel Improvement & Forge Co., The, 960 Addison Rd., Cleveland, Ohio
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

GASOLINE DYES—See DYES, Gasoline:

GAUGE COCKS—See COCKS, Gauge:

GAGE GLASSES:
Burt Tank, Separator & Oil Treating Corp., Wichita Falls, Tex.
Corning Glass Works, Corning, N. Y.
Inferno Co., Shreveport, La.
Jerguson Gage & Valve Co., Somerville, Mass.
Lunkenheimer Co., The, Cincinnati, Ohio
Nathan Mfg. Co., 416 E. 106th St., New York City
National Lead Co., 111 Broadway, New York City
Powell, Wm., Co., The, Cincinnati, Ohio
Swift Lubricator Co., Elmira, N. Y.
Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.

GAUGE HATCHES—See TANK GAUGE and THIEF HATCHES:

GAUGE-REPAIR SERVICE—See INSTRUMENT-REPAIR SERVICE:

GAUGE-TESTING EQUIPMENT:
Ashton Valve Co., Cambridge, Mass.
Blackhawk Mfg. Co., Milwaukee, Wis.
Crosby Steam Gage & Valve Co., 165 Broadway, New York City
Engineering Laboratories, Tulsa, Okla.
Grove Regulator Co., Oakland, Calif.
Lonergan, J. E. Co., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Marsh, Jas. P., Corp., 2065 Southport, Chicago, Ill.
Marshalltown Mfg. Co., Marshalltown, Iowa
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Star Brass Mfg. Co., Boston, Mass.
Trerice, H. O., Co., Detroit, Mich.

GAUGES—Absolute Pressure:
Bristol Co., The, Waterbury, Conn.
Engineering Laboratories, Tulsa, Okla.
Foxboro Co., Foxboro, Mass.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Marsh, Jas. P., Corp., 2065 Southport, Chicago, Ill.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
United States Gauge Co., 14 Wall St., New York City

GAUGES—Automatic, Tank:
Guardian Electric Co., 1623 W. Walnut St., Chicago, Ill.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Nathan Mfg. Co., 416 E. 106th St., New York City
Pneumercator Co., 305 E. 46th St., New York City
Shand & Jurs Co., Berkeley, Calif.
Swift Lubricator Co., Elmira, N. Y.
Tokheim Co., Cedar Rapids, Iowa
Vapor Recovery Systems Co., The, Compton, Calif.
Viking Pump Co., Cedar Falls, Iowa

MARSH GAUGES

Marsh Mastergauge

MARSH Gauges are known not only for their accuracy, but, still more important, for their ability to *stay* accurate year after year.

Included in the Marsh line are indicating pressure gauges for practically all services in all standard ranges up to 30,000 lbs., also vacuum, compound, and altitude gauges, recording gauges, diaphragm attachment, pulsation dampener, and other special purpose types.

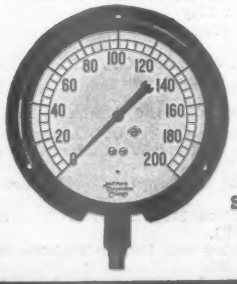
Precision-built throughout—

In every detail Marsh Gauges reflect more than 75 years of experience in instrument manufacturing. Bourdon tubes are held to strict standards. Movements have machine-cut gearing. Bearings and staffs are accurately reamed to close, but practically frictionless fitting. The 270°-arc movement is so designed that all dial graduations are evenly spaced, facilitating reading. All have the Marsh "Unit Construction" in which the bourdon tube, movement and dial are assembled on the socket, the case merely acting as an enclosure, so that external shocks are not communicated to working parts. All standard types of cases, dial sizes and finishes are available.

The Gauge with the Recalibrator

An outstanding feature of Marsh Gauges is the "Recalibrator" which provides the only proper means of correcting a gauge that has been knocked out of adjustment—by correcting for distortion of the bourdon tube. Simply turn the "Recalibrator" screw, and the gauge is corrected for *all points* on the dial. Re-setting the hand does not accomplish this.

Marsh Gauges are designated as "standard" (for ordinary service), "bronze bushed" (for more severe service) and "Mastergauge" (for extreme service). The Marsh "Mastergauge" sets a new standard for gauge accuracy and stamina, proved by the ever-growing preference accorded it for applications where extreme service conditions are encountered.



Marsh Standard Gauge

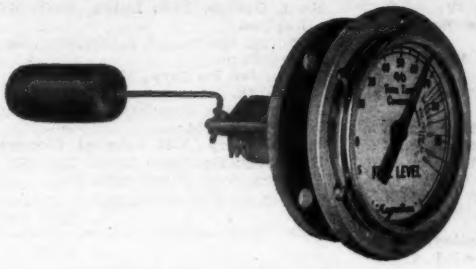
JAS. P. MARSH CORPORATION
2065 Southport Avenue, Chicago, Illinois

GAUGES—Compound Pressure and Vacuum, Indicating:
Ashton Valve Co., Cambridge, Mass.
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Crosby Steam Gage & Valve Co., 165 Broadway, New York City
Engineering Laboratories, Tulsa, Okla.
Foxboro Co., Foxboro, Mass.
Kent, George, Ltd., Luton, Bedfordshire, England
Lonergan, J. E., Co., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Marsh, Jas. P., Corp., 2073 Southport, Chicago, Ill.
Marshalltown Mfg. Co., Marshalltown, Iowa
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Newman, Hender & Co., Ltd., Woodchester, England
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. C., Co., Detroit, Mich.
United States Gauge Co., 14 Wall St., New York City

GAUGES—Hydraulic:
Ashton Valve Co., Cambridge, Mass.
Blackhawk Mfg. Co., Milwaukee, Wis.
Bristol Co., The, Waterbury, Conn.
Crosby Steam Gage & Valve Co., 165 Broadway, New York City
Foxboro Co., Foxboro, Mass.
Kent, George, Ltd., Luton, Bedfordshire, England
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Marsh, Jas. P., Corp., 2073 Southport, Chicago, Ill.
Marshalltown Mfg. Co., Marshalltown, Iowa
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Newman, Hender & Co., Ltd., Woodchester, England
Star Brass Mfg. Co., Boston, Mass.
Trerice, H. C., Co., Detroit, Mich.
United States Gauge Co., 14 Wall St., New York City

GAUGES—Liquid Level, Indicating:
Automatic Temperature Control Co., 34 E. Logan St., Philadelphia, Pa.
Bowser, S. F., & Co., Fort Wayne, Ind.
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Crosby Steam Gage & Valve Co., 165 Broadway, New York City
Foxboro Co., Foxboro, Mass.
Frick Co., Waynesboro, Pa.
General Electric Co., Schenectady, N. Y.
Guardian Electric Co., 1623 W. Walnut St., Chicago, Ill.
Inferno Co., Shreveport, La.
Jerguson Gage & Valve Co., Somerville, Mass.
Johnston & Jennings, 877 Addison Rd., Cleveland, Ohio
Kent, George, Ltd., Luton, Bedfordshire, England
King Engineering Corp., Ann Arbor, Mich.
King-Seeley Corp., Ann Arbor, Mich.
Klinger, Richard, Ltd., Sidcup (Kent), England
Klingerit, Inc., 16 Hudson St., New York City
Liquidometer Corp., The, Long Island City, N. Y.
Lunkenheimer Co., The, Cincinnati, Ohio
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Marsh, Jas. P., Corp., 2073 Southport, Chicago, Ill.
Marshalltown Mfg. Co., Marshalltown, Iowa
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Meriam Co., The, 1955 W. 112th St., Cleveland, Ohio
Moore Products Co., Philadelphia, Pa.
Nathan Mfg. Co., 416 E. 106th St., New York City
Newman, Hender & Co., Ltd., Woodchester, England
Oil Well Supply Co., Dallas, Tex.

Rochester Dial Magnetic Liquid-Level Gauges



Model 4 MGFR Geared Action Type

Magnetron Gauge illustrated above is available in dial diameters of 2"—4"—8"

Magnetron Gauge type as shown below available in 4" and 8" dial diameters.

These Gauges are designed especially for use with Butane, Propane and other light liquids. As the name implies, "MAGNETRONS" are magnetic type Gauges which can be mounted on the top, side, end or bottom of tanks, Magnetized pointer is turned by means of a magnet on Gauge center shaft. Absence of shaft connection through forged brass head insures leak-proof construction even under high pressures. Center shaft is rotated by means of a float rod and gear mechanism; the float traveling in a 140° arc. Listed as standard by Underwriters' Laboratories for use on pressure or vented vessels.

Model 3160

Model 1725

Rochester Dial Thermometers

The 1000° Fahrenheit thermometer (illustrated) is designed for service on exhaust manifolds and other high temperature applications. Bimetal coil—extremely fast action. Model 1725 is direct indicating type with standard ½" pipe thread and 3" dial. Rochester Dial Thermometers also available in Vapor Pressure types. All are individually calibrated for dependable accuracy Sealed against dust and water with indicating mechanism parts of rust-resisting metals.

For complete information on Liquid-Level Gauges, write for Bulletin L.G.A. 112 and Bulletin GG 343 pertaining to Dial Thermometers.

Rochester Manufacturing Co., Inc.

36 Rockwood St. Rochester, N. Y.

ROCHESTER *Individually Calibrated* GUARANTEED ACCURATE INSTRUMENTS

FOR ACCURATE LIQUID-LEVEL, PRESSURE and TEMPERATURE INDICATION

GAUGES—Liquid Level Indicating (Continued):

Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich.
Powell, Wm., Co., The, Cincinnati, Ohio
Rochester Mfg. Co., Inc., Rochester, N. Y.
Shand & Jurs Co., Berkeley, Calif.
Simplex Valve & Meter Co., 68th and Upland Sts., Philadelphia, Pa.
Swift Lubricator Co., Elmira, N. Y.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Tokheim Co., Cedar Rapids, Iowa
Trerice, H. O., Co., Detroit, Mich.
Vapor Recovery Systems Co., The, Compton, Calif.
Viking Pump Co., Cedar Falls, Iowa
Vogt, Henry, Machine Co., Louisville, Ky.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.
Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.

GAUGES—Liquid Level, Recording:

Bailey Meter Co., 1038 Ivanhoe Rd., Cleveland, Ohio
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Crosby Steam Gage & Valve Co., 165 Broadway, New York City
Foxboro Co., Foxboro, Mass.
Kent, George, Ltd., Luton, Bedfordshire, England
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Liquidometer Corp., The, Long Island, City, N. Y.
McAlear Mfg. Co., 1901 S. Western, Chicago, Ill.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Moore Products Co., Philadelphia, Pa.
Republic Flow Meters Co., Chicago, Ill.
Simplex Valve & Meter Co., 68th and Upland Sts., Philadelphia, Pa.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. O., Co., Detroit, Mich.

GAUGES—Pressure, Indicating:

Ashton Valve Co., Cambridge, Mass.
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Connelly Iron Sponge & Governor Co., 3154 S. California, Chicago, Ill.
Crosby Steam Gage & Valve Co., 165 Broadway, New York City
Engineering Laboratories, Tulsa, Okla.
Foxboro Co., Foxboro, Mass.
General Electric Co., Schenectady, N. Y.
Hays, A. M., Corp., Michigan City, Ind.
Kent, George, Ltd., Luton, Bedfordshire, England
King-Seeley Corp., Ann Arbor, Mich.
Lonergan, J. E., Co., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Marsh, Jas. P., Corp., 2065 Southport, Chicago, Ill.
Marshalltown Mfg. Co., Marshalltown, Iowa
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Meriam Co., The, 1955 W. 112th St., Cleveland, Ohio
Oil Well Supply Co., Dallas, Tex.
Pittsburgh Equitable Meter Co., 400 Lexington Ave., Pittsburgh, Pa.
Republic Flow Meters Co., Chicago, Ill.
Rochester Mfg. Co., Inc., Rochester, N. Y.
Star Brass Mfg. Co., Boston, Mass.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice H. O., Co., Detroit, Mich.
United States Gauge Co., 14 Wall St., New York City
Westinghouse Air Brake Co., Wilmerding, Pa.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

GAUGES—Pressure, Recording:

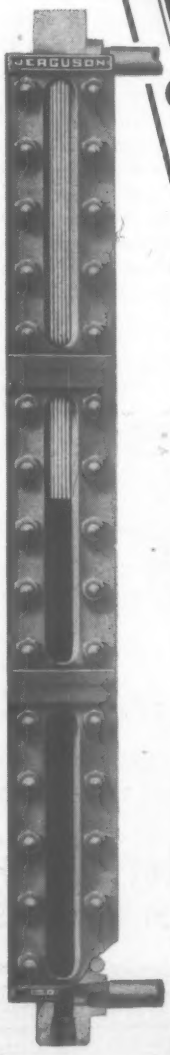
Bailey Meter Co., 1038 Ivanhoe Rd., Cleveland, Ohio
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Crosby Steam Gage & Valve Co., 165 Broadway, New York City
Engineering Laboratories, Tulsa, Okla.
Esterline Angus Co., Indianapolis, Ind.
Foxboro Co., Foxboro, Mass
Kent, George, Ltd., Luton, Bedfordshire, England
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Marsh, Jas. P., Corp., 2065 Southport, Chicago, Ill.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Pittsburgh Equitable Meter Co., 400 Lexington Ave., Pittsburgh, Pa.
Republic Flow Meters Co., Chicago, Ill.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. O., Co., Detroit, Mich.
United States Gauge Co., 14 Wall St., New York City
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

GAUGES, Reflex:

Jerguson Gage & Valve Co., Somerville, Mass.
Klinger, Richard, Ltd., Sidcup (Kent), England
Klingerit, Inc., 16 Hudson St., New York City
Nathan Mfg. Co., 416 E. 106th St., New York City
Newman, Hender & Co., Ltd., Woodchester, England

JERGUSON

Gages for HIGH Pressures or HIGH Temperatures



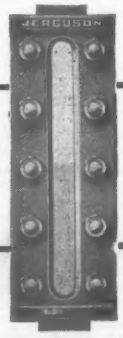
JERGUSON Gages . . . with alloy and forged steel for parts subjected to the stresses . . . U-Bolt construction . . . carefully processed glass . . . these contribute toward the satisfactory service JERGUSON Gages are giving in refineries and natural gasoline plants.

They add up to dependability and durability . . . with the JERGUSON Reflex design assuring readability even at a distance. Empty space always shows white; space filled with liquid shows black.

• • •

Standard JERGUSON Reflex Gages are designed for service conditions involving pressures up to 3200 pounds at 100° F. and up to 1200 pounds at 1000° F.

Standard Transparent Gages are for pressures up to 2000 pounds at 100° F. and up to 600 pounds at 1000° F. Where steam is encountered, the glass is mica-protected.



Gages with close hook-up side connections as shown permit a maximum of visibility for a given distance between valves.

JERGUSON GAGE & VALVE CO.

85 Fellsway Somerville, Mass.

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U. S. SUPERGAUGES

U. S. SUPERGAUGES have been designed to meet the particular requirements of Refinery and Pipe Line Installations. They are carefully manufactured from thoroughly tested materials and will give long service with a guaranteed accuracy of ½ of 1% of the scale range. They will withstand the effects of excessive pulsation or vibration and of high temperatures.

U. S. GAUGE CO.

14 WALL STREET — U.S. GAUGE CO. N.Y. — NEW YORK, N. Y.

Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich.

GAUGES—Tank:
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Detroit Lubricator, 5900 Trumbull Ave., Detroit, Mich.
Guardian Electric Co., 1623 W. Walnut St., Chicago, Ill.
Johnston & Jennings Co., The, Cleveland, Ohio
Jerguson Gage & Valve Co., Somerville, Mass.
King Engineering Corp., Ann Arbor, Mich.
Liquidometer Corp., The, Long Island City, N. Y.
Lufkin Rule Co., Saginaw, Mcih.
Maloney Tank Mfg. Co., Tulsa, Okla.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Meriam Co., The, 1955 W. 112th St., Cleveland, Ohio
Nathan Mfg. Co., 416 E. 106th St., New York City
National Airoil Burner Co., 1236 E. Sedgley Ave, Philadelphia, Pa.
Newman, Hender & Co., Ltd., Woodchester, England
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich.
Precision Scientific Co., 1750 N. Springfield Ave., Chicago, Ill.
Rochester Mfg. Co., Inc., Rochester, N. Y.
Shand & Jurs Co., Berkeley, Calif.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Tokheim Co., Cedar Rapids, Iowa
Vapor Recovery Systems Co., The, Compton, Calif.
Viking Pump Co., Cedar Falls, Iowa

GAUGES—Temperature, Indicating:
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Engineering Laboratories, Tulsa, Okla.
Foxboro Co., Foxboro, Mass.
King-Seeley Corp., Ann Arbor, Mcih.
Leeds & Northrup Co., 4901 Stenton, Ave., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Marsh, Jas. P., Corp., 2073 Southport, Chicago, Ill.
Marshalltown Mfg. Co., Marshalltown, Iowa
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Precision Scientific Co., 1750 N. Springfield Ave., Chicago, Ill.
Rochester Mfg. Co., Inc., Rochester, N. Y.
Sarco Co., Inc., 475 Fifth Ave., New York City
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Tokheim Co., Cedar Rapids, Iowa
Trerice, H. O., Co., Detroit, Mich.
United States Gauge Co., 14 Wall St., New York City
Weston Electrical Instrument Corp., Newark, N. J.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

GAUGES—Temperature, Recording:
Bailey Meter Co., 1038 Ivanhoe Rd., Cleveland, Ohio
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Engineering Laboratories, Tulsa, Okla.
Foxboro Co., Foxboro, Mass.
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Marsh, Jas. P., Corp., 2065 Southport, Chicago, Ill.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. O., Co., Detroit, Mich.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

GAUGES—U-Tube—See MAGNETOMETERS, U-Type:

GAUGES—Vacuum, Indicating:
Amthor Testing Instrument Co., Inc., 50 Van Sinderen Ave., Brooklyn, N. Y.
Ashton Valve Co., Cambridge, Mass.
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves, Philadelphia, Pa.
Crosby Steam Gage & Valve Co., 165 Broadway, New York City
Foxboro Co., Foxboro, Mass.
General Electric Co., Schenectady, N. Y.
Hays, A. M., Corp., Michigan City, Ind.
Kent, George, Ltd., Luton, Bedfordshire, England
Lonergan, J. E., Co., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.

SPECIFY "Varec" APPROVED

GASTIGHT AUTOMATIC TANK GAUGES

Accurate to 1/16 of an inch.

"The Pace Setter"

The Vapor Recovery Systems Co.

Stock Offices: COMPTON, CALIF. Stocks Carried: NEW YORK CITY TULSA OKLA HOUSTON TEX

Marsh, Jas. P., Corp., 2065 Southport, Chicago, Ill.
Marshalltown Mfg. Co., Marshalltown, Iowa
Meriam Co., The, 1955 W. 112th St., Cleveland, Ohio
Newman, Hender & Co., Ltd., Woodchester, England
Pittsburgh Equitable Meter Co., 400 Lexington Ave., Pittsburgh, Pa.
Rochester Mfg. Co., Inc., Rochester, N. Y.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. O., Co., Detroit, Mich.
United States Gauge Co., 14 Wall St., New York City

GAUGES—Vacuum Recording:
Bristol Co., The Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Crosby Steam Gage & Valve Co., 165 Broadway, New York City
Esterline Angus Co., Indianapolis, Ind.
Foxboro Co., Foxboro, Mass.
Hays, A. M., Corp., Michigan City, Ind.
Kent, George, Ltd., Luton, Bedfordshire, England
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Marsh, Jas. P., Corp., 2065 Southport, Chicago, Ill.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Pittsburgh Equitable Meter Co., 400 Lexington Ave., Pittsburgh, Pa.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. O., Co., Detroit, Mich.
United States Gauge Co., 14 Wall St., New York City

GAUGING POLES—See POLES, Tank Gauging:

GAUGING TAPES—See TAPES, Gauging:

GEAR-MOTORS:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Fairbanks, Morse Co., 600 S. Michigan Ave., Chicago, Ill.
Falk Corp., Milwaukee, Wis.
Foote Brothers Gear & Machine Co., 4545 S. Western, Chicago, Ill.
United States Gauge Co., 14 Wall St., New
General Electric Co., Schenectady, N. Y.
Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia, Pa.
Master Elecfric Co., Dayton, Ohio
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

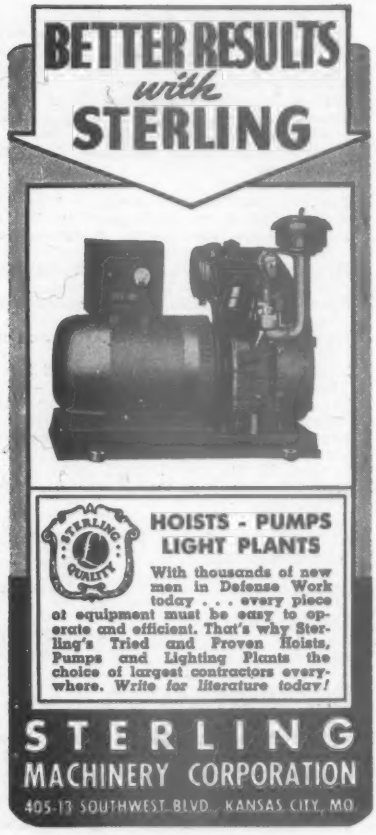
GEAR REDUCTION UNITS:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Bethlehem Steel Co., Bethlehem, Pa.
Cotta Transmission Corp., Rockford, Ill.
DeLaval Steam Turbine Co., Trenton, N. J.
Falk Corp., Milwaukee, Wis.
Farrel-Birmingham Co., Inc., Buffalo, N. Y,
Foote Brothers Gear & Machine Co., 4545 S. Western, Chicago, Ill.
James, D. O., Mfg. Co., 114 Monroe St., Chicago, Ill.
Jones, W. A., Foundry & Machine Co., 4401 W. Roosevelt Rd., Chicago, Ill.
Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia, Pa.
Marley Co., The, Kansas City, Kans.
Medart Co., St. Louis, Mo.
National Supply Co., Toledo, Ohio
Ohio Forge & Machine Corp., 3010 Woodhill Rd., Cleveland, Ohio
Oil Well Supply Co., Dallas, Tex.
Ottumwa Iron Works, Ottumwa, Iowa
Philadelphia Gear Works, Erie Ave. and G St., Philadelphia, Pa.
Poole Foundry & Machine Co., Baltimore, Md.
Terry Steam Turbine Co., The, Hartford, Conn.
Waukesha Motor Co., Waukesha, Wis.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

GEAR-TURBINES:

Coppus Engineering Co., Worcester, Mass.
DeLaval Steam Turbine Co., Trenton, N. J.
General Electric Co., Schenectady, N. Y.
Murray Iron Works Co., Burlington, Iowa
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

GENERATING PLANTS—Gasoline-Driven:

Sterling Machinery Corp., Kansas City, Mo.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HOISTS - PUMPS
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With thousands of new men in Defense Work today . . . every piece of equipment must be easy to operate and efficient. That's why Sterling's Tried and Proven Hoists, Pumps and Lighting Plants the choice of largest contractors everywhere. Write for literature today!
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MACHINERY CORPORATION
405-13 SOUTHWEST BLVD., KANSAS CITY, MO.

GENERATOR SETS:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Allis, Louis, Co., The, Milwaukee, Wis.
Buda Co., Harvey, Ill.
Buffalo Gasolene Motor Co., Buffalo, N.Y.
Carling Turbine Blower Co., Worcester, Mass.
Caterpillar Tractor Co., Peoria, Ill.
Climax Engineering Co., Dallas, Tex.
Continental Electric Co., 335 Ferry St., Newark, N. J.
Crocket-Wheeler Electric Mfg. Co., Ampere, N. J.
DeLaval Steam Turbine Co., Trenton, N. J.
Elliott Co., Jeannette, Pa.
General Electric Co., Schenectady, N. Y.
Homelite Corp., Port Chester, N. Y.
Ideal Electric & Mfg. Co., Mansfield, Ohio
Ingersoll-Rand Co., 11 Broadway, New York City
Le Roi Co., Milwaukee, Wis.
Master Electric Co., Dayton, Ohio
Moon Mfg. Co., 122 N. Jefferson, Chicago, Ill.
Murphy Diesel Co., Milwaukee, Wis.
National Supply Co., Toledo, Ohio
Nelson Electric Mfg. Co., Tulsa, Okla.
Onan, D. W., & Sons, Minneapolis, Minn.
Pioneer Gen-E-Motor Corp., 466 W. Superior, Chicago, Ill.
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.
Terry Steam Turbine Co., The, Hartford, Conn.
Troy Engine & Machine Co., Troy, Pa.
Universal Motor Co., Oshkosh, Wis.
Weber Engine Works, Kansas City, Mo.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Witte Engine Works, Kansas City, Mo.

GENERATORS — Acetylene: See ACETYLENE GENERATORS:

GENERATORS—Electric:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Allis, Louis, Co., The, Milwaukee, Wis.
Buffalo Gasolene Motor Co., Buffalo, N. Y.
Century Electric Co., St. Louis, Mo.
Continental Electric Co., 335 Ferry St., Newark, N. J.
Crocker-Wheeler Electric Mfg. Co., Ampere, N. J.
Electric Machinery Mfg. Co., Minneapolis, Minn.
Elliott Co., Jeannette, Pa.
Fairbanks, Morse Co., 600 S. Michigan Ave., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Homelite Corp., Port Chester, N. Y.
Ideal Electric & Mfg. Co., Mansfield, Ohio
Master Electric Co., Dayton, Ohio
Moon Mfg. Co., 122 N. Jefferson, Chicago, Ill.
Nelson Electric Mfg. Co., Tulsa, Okla.
Pioneer Gen-E-Motor Corp., 466 W. Superior, Chicago, Ill.
Sterling Machinery Corp., Kansas City, Mo.
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.
Troy Engine & Machine Co., Troy, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

GENERATOR UNITS—Turbine-Driven:

Allen Sons & Co., Ltd., W. H., Bedford, England
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Climax Engineering Co., Dallas, Tex.
Continental Electric Co., 335 Ferry St., Newark, N. J.
DeLaval Steam Turbine Co., Trenton, N. J.
Elliott Co., Jeannette, Pa.
General Electric Co., Schenectady, N. Y.
Moon Mfg. Co., 122 N. Jefferson, Chicago, Ill.
Murray Iron Works Co., Burlington, Iowa
Pyle National Co., 1334 N. Kostner, Chicago, Ill.
Terry Steam Turbine Co., The, Hartford, Conn.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

GLASSWARE, Laboratory: See LABORATORY, Glassware:

GOGGLES—Protective:

Air Reduction Sales Co., 60 E. 42nd St., New York City
American Optical Co., Southbridge, Mass.
Boyer-Campbell Co., 6540 S. Antoine St., Detroit, Mich.
Goggle Parts Co., The, Century Bldg., Cleveland, Ohio
Industrial Products Co., 2828 N. Fourth St., Philadelphia, Pa.
Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh, Pa.
National Cylinder Gas Co., 205 W. Wacker, Chicago, Ill.
Sellstrom Mfg. Co., 615 N. Aberdeen, Chicago, Ill.

GOVERNORS — See also CONTROLLERS and REGULATORS:

GOVERNORS—Engine:

Pierce Governor Co., The, Anderson, Ind.

GOVERNORS—Pump:

American Meter Co., 60 East 42nd St., New York City
Atlas Valve Co., 276 South St., Newark, N. J.
Cash, A. W., Co., Decatur, Ill.
Chaplin-Fulton Mfg. Co., 28-40 Penn Ave., Pittsburgh, Pa.
Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago, Ill.
Fisher Governor Co., Marshalltown, Iowa
Foster Engineering Co., Newark, N. J.
Foster Pump Works, Inc., 50 Washington St., Brooklyn, N. Y.
Grove Regulator Co., Oakland, Calif.
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Hanlon-Waters, Inc., Tulsa, Okla.
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
Inferno Co., Shreveport, La.
Jarecki Mfg. Co., St. Louis, Mo.
Kieley & Mueller, Inc., North Bergen, N. J.
Leslie Co., Lyndhurst, N. J.
McAlear Mfg. Co., 1901 S. Western, Chicago, Ill.
McDonnell & Miller, Wrigley Bldg., Chicago, Ill.
Mason Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Mueller Co., Decatur, Ill.
Natural Gas Equipment, Inc., Los Angeles, Calif.
Northern Equipment Co., Erie, Pa.
Reading-Pratt & Cady Div. of the American Chain & Cable Co., Inc., Reading, Pa.
Spence Engineering Co., Inc., Walden, N. Y.
Squires, C. E., Co., 3934 Kelly Ave., Cleveland, Ohio
Strong, Carlisle & Hammond Co., The, 1392 W. Third St., Cleveland, Ohio
Swartwout Co., The, 18511 Euclid Ave., Cleveland, Ohio
Trerice, H. O., Co., Detroit, Mich.
Westinghouse Air Brake Co., Wilmerding, Pa.

GRATING—Steel:

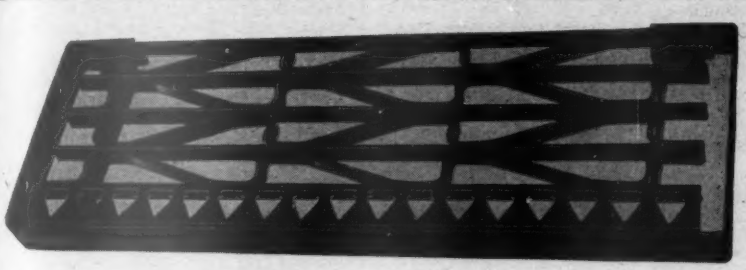
Allied Steel Products Corp., Tulsa, Okla.
American Abrasive Metals Co., Irvington, N. J.

RELIANCE GRATING
WITH
DEEP WELDED CROSS BARS
AND
FERALUN ANTI SLIP NOSING TREADS
SAFER
STRONGER
STIFFER
AMERICAN ABRASIVE METALS CO.
Irvington, N. J.

Arrowhead Iron Works, Inc., Kansas City, Mo.
Bates Co., Inc., Walter, Chicago, Ill.
Blaw-Knox Co., Blawnox, Pa.
Borden Metal Products Co., Elizabeth, N. J.
Hendrick Mfg. Co., Carbondale, Pa.
Irving Subway Grating Co., Inc., 50-25 27th St., Long Island City, N. Y.
Jorgenson, Earle M., Co., 5311 Clinton Drive, Houston, Tex.
Kerlow Steel Flooring Co., Jersey City, N. J.
Klemp, Wm. F., Co., 6624 S. Melvina, Chicago, Ill.
Mosher Steel Co., Houston, Tex.
Open Steel Flooring Institute, Pittsburgh, Pa.
Patterson Steel Co., Tulsa, Okla.
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Standard Steel Spring Co., Gary, Ind.
Truscon Steel Co., Youngstown, Ohio
Watkins, Inc., Wichita, Kans.

GRAVITY RECORDERS—See RECORDERS, Gravity:

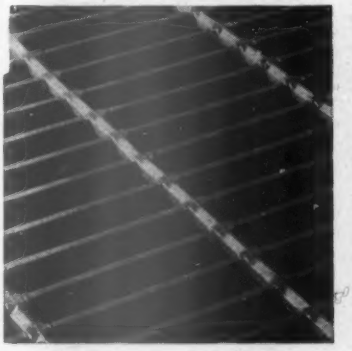
GREASE CUPS—See CUPS, Grease:



ARROWHEAD IRON WORKS

500 West 5th Street Kansas City, Mo.

GARY-WELDED GRATING and TREADS



Tailor-Made in all sizes for your individual requirements.

Square Edge Bars—Your assurance of a slip-proof surface.

Hexagonal Cross Bars for neat appearance and better welds.

Engineering Data and Samples mailed on request.

STANDARD STEEL SPRING COMPANY

Copen Steel Floor Grating Division

2750 EAST 5TH AVENUE GARY, INDIANA

GREASE-MAKING EQUIPMENT:
Biggs Boiler Works, The, Akron, Ohio
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Hendrick Mfg. Co., Carbondale, Pa.
Patterson Foundry & Machine Co., East Liverpool, Ohio
Sowers Mfg. Co., Buffalo, N. Y.
Standard Steel Corp., Los Angeles, Calif.
Stratford Engineering Corp., Kansas City, Mo.

GREASE KETTLES—See KETTLES, Grease:

GRINDERS—Pneumatic:
Airetool Mfg. Co., Springfield, Ohio
Chicago Pneumatic Tool Co., 6 E. 44th St., New York City
Ingersoll-Rand Co., 11 Broadway, New York City

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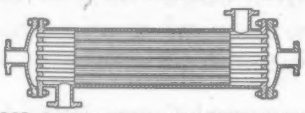
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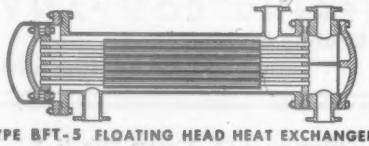
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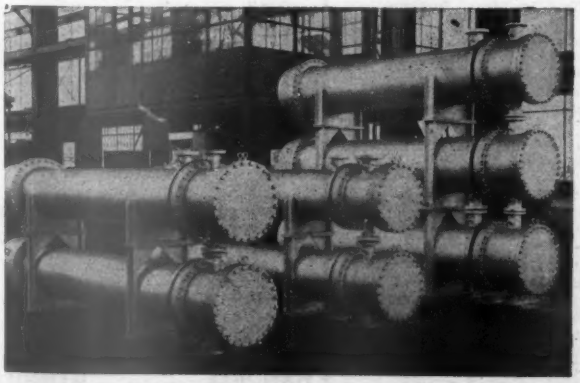

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Gustin-Bacon Mfg. Co., Kansas City, Mo.
Happy Co., The, Tulsa, Okla.
Hewitt Rubber Corp., Buffalo, N. Y.
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
N. Y. Rubber Corp., 9 Rockefeller Plaza, New York City
Quaker Rubber Corp., Philadelphia, Pa.
Republic Rubber Co., The, Youngstown, Ohio
Sterling Packing & Gasket Co., Houston, Tex.
Thermoid Co., Trenton, N. J.
U. S. Rubber Co., 1230 6th Ave., New York City

HOSE—Steam, Metal:
American Brass Co., 25 Broadway, New York City
Atlantic Metal Hose Co., 123 W. 64th St., New York City
Chicago Metal Hose Corp., Maywood, Ill.
Chiksan Tool Co., Brea, Calif.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Pennsylvania Flexible Metallic Tubing Co., 72nd and Powers Lane, Philadelphia, Pa.
Quaker Rubber Corp., Philadelphia, Pa.
Seamlex Co., Inc., 5-19 48th Ave., Long Island City, N. Y.

HOSE—Tar and Asphalt:
American Brass Co., 25 Broadway, New York City
Chicago Metal Hose Corp., Maywood, Ill.
Chiksan Tool Co., Brea, Calif.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Pennsylvania Flexible Metallic Tubing Co., 72nd and Powers Lane, Philadelphia, Pa.
Republic Rubber Co., The, Youngstown, Ohio
Resistoflex Corp., Belleville, N. J.
Wilkinson Rubber Linatex, Ltd., Camberley (Surrey), England

HOSE—Water:
Carlyle Rubber Co., 64 Park Place, New York City
Chicago Metal Hose Corp., Maywood, Ill.
Chiksan Tool Co., Brea, Calif.
Cincinnati Rubber Mfg. Co., The, Norwood Sta., Cincinnati, Ohio
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodrich, B. F., Co., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Happy Co., The, Tulsa, Okla.
Hewitt Rubber Corp., Buffalo, N. Y.
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
N. Y. Rubber Corp., 9 Rockefeller Plaza, New York City
Pennsylvania Flexible Metallic Tubing Co., 72nd and Powers Lane, Philadelphia, Pa.
Quaker Rubber Corp., Philadelphia, Pa.
Republic Rubber Co., The, Youngstown, Ohio
Sterling Packing & Gasket Co., Houston, Tex.
Thermoid Co., Trenton, N. J.
U. S. Rubber Co., 1230 6th Ave., New York City
Walker, W. L., Co., Tulsa, Okla.
Wilkinson Rubber Linatex, Ltd., Camberley (Surrey), England

HOUSES—Sectional, Wood—See BUILDINGS, Sectional, Wood:

HOUSES—Tool, Steel:
Allied Steel Products Corp., Tulsa, Okla.
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Blaw-Knox Co., Blawnox, Pa.
Braden Steel Corp., Tulsa, Okla.
Burt Tank, Separator & Treating Corp., Wichita Falls, Tex.
Butler Mfg. Co., Kansas City, Mo.
M & V Tank Co., Wichita Falls, Tex.
Mosher Steel Co., Houston, Tex.
Standard Steel Corp., Los Angeles, Calif.
Truscon Steel Co., Youngstown, Ohio
Watkins, Inc., Wichita, Kans.
Wyatt Metal & Boiler Works, Houston, Tex.

HOUSES—Meter:
Allied Steel Products Corp., Tulsa, Okla.
Butler Mfg. Co., Kansas City, Mo.
Daniel Orifice Fitting Co., Los Angeles, Calif.
Watkins, Inc., Wichita, Kans.

HYDRANTS—Fire:
Darling Valve & Mfg. Co., Williamsport, Pa.
Kennedy Valve Mfg. Co., The, Elmira, N. Y.
Ludlow Valve Mfg. Co., Troy, N. Y.
M & H Valve & Fittings Co., Anniston, Ala.
Manistee Iron Works, Manistee, Mich.
Mueller Co., Decatur, Ill.

HYDRAULIC DECOKING EQUIPMENT—See DECOKING EQUIPMENT, Hydraulic:

HYDROGEN SULFIDE DETECTORS—See DETECTORS, Hydrogen Sulfide:

HYDROGEN SULFIDE REMOVAL — See PROCESSES, Gas Purification:

HYDROMETERS:
Greiner, Emil, Co., 55 Van Dam St., New York City
H.-B. Instrument Co., Inc., N. Broad St., Philadelphia, Pa.
Kimble Glass Co., Vineland, N. J.
Nurnberg Thermometer Co., 397 Bridge St., Brooklyn, N. Y.
Oil Well Supply Co., Dallas, Tex.
Refinery Supply Co., Tulsa, Okla.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. O., Co., Detroit, Mich.
Willard Storage Battery Co., E. 131st St. and St. Clair Ave., Cleveland, Ohio

HYGROMETERS:
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Cambridge Instrument Co., Inc., 3732 Grand Central Terminal, New York City
Foxboro Co., Foxboro, Mass.
Greiner, Emil, Co., 55 Van Dam St., New York City
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Nurnberg Thermometer Co., 397 Bridge St., Brooklyn, N. Y.
Palmer Co., The, Cincinnati, Ohio
Refinery Supply Co., Tulsa, Okla.
Tagliabue, C. J., Mfg. Co., Park Ave. and Nostrand Ave., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. O., Co., Detroit, Mich.

IDLERS—Belt:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Dodge Mfg. Co., Mishawaka, Ind.
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Happy Co., The, Tulsa, Okla.
Jeffrey Mfg. Co., The, Columbus, Ohio
Link-Belt Co., 220 S. Belmont Ave., Indianapolis, Ind.
Marion Machine Foundry & Supply Co., Marion, Ind.
Medart Co., 3535 De Kalb St., St. Louis, Mo.
National Supply Co., Toledo, Ohio
Oil Well Supply Co., Dallas, Tex.

ILLUMINATORS—For Water Gauges:
Inferno Co., Shreveport, La.
Wright-Austin Co., Detroit, Mich.
Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.

INDICATORS — Combustible Gas — See ALARMS, Combustible Gas:

INDICATORS—Draft—See GAUGES, Draft:

INDICATOR—Flow—See METERS, Flow:

INDICATORS, Liquid-Level—See GAUGES, Liquid-Level:

INDICATORS—Temperature—See GAUGES:

INHIBITORS:
American Chemical Paint Co., Ambler, Pa.
American Cyanamid & Chemical Corp., 30 Rockefeller Plaza, New York City
American Lecithin Co., Inc., Elmhurst, Long Island, N. Y.
Du Pont de Nemours, E. I., & Co., Wilmington, Del.
Elgin Softener Corp., Elgin, Ill.
D. W. Haering Co., Chicago, Ill.
Horn, A. C., Co., Houston, Tex.
Reilly Tar & Chemical Co., Indianapolis, Ind.
Universal Oil Products Co., 310 S. Michigan Ave., Chicago, Ill.

INJECTORS:
McDonnell & Miller, Wrigley Bldg., Chicago, Ill.
Nathan Mfg. Co., 416 E. 106th St., New York City
Newman, Hender & Co., Ltd., Woodchester, England
Ohio Injector Co., Wadsworth, Ohio
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich.

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SOUTH AMERICA
Maracaibo, Ven.
Las Piedras, Ven.
Puerto La Cruz, Ven.
Caripito, Ven.
Guiria, Ven.
Tampico, Mexico

GULF COAST
New Orleans, La.
Baton Rouge, La.
Lake Charles, La.
Vicksburg, Miss.
Texas City, Tex.
Corpus Christi, Tex.
Port Isabel, Tex.
Houston, Tex.
Port Arthur, Tex.

WEST COAST
Wilmington, Calif.
San Francisco, Calif.
San Luis Obispo, Cal.

WEST INDIES
Curacao, N. W. I.
Aruba, N. W. I.
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INSTRUMENTS — OIL-Testing — See OIL-TESTING INSTRUMENTS:

INSTRUMENTS—See Specific Types:

INSTRUMENT-REPAIR SERVICE:
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves, Philadelphia, Pa.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Foxboro Co., Foxboro, Mass.
Instruments, Inc., Dallas, Tex.
Marsh, Jas. P., Corp., 2073 Southport, Chicago, Ill.
Minneapolis Honewell Regulator Co., Minneapolis, Minn.
Refinery Supply Co., Tulsa, Okla.
Trerice, H. O., Co., Detroit, Mich.
Taylor Instrument Companies, Rochester, N. Y.

Weston Electrical Instrument Corp., Newark, N. J.

INSULATING CEMENT—See CEMENT, Insulating:

INSULATING MATERIALS—See Specific Headings:

—INSULATION—Asbestos:
Asbestos & Engineering Products, Ltd., London, England
Baldwin-Hill Co., Trenton, N. J.
Bird-Archer Co., Wrigley Bldg., Chicago, Ill.
British Belting & Asbestos, Ltd., Cleckheaton, Yorkshire, England
Carey, Philip, Mfg. Co., The, Cincinnati, Ohio
Forty Eight Insulations, Inc., North Aurora, Ill.
Gatke Corp., 228 N. La Salle St., Chicago, Ill.
Johns-Manville Corp., 22 E. 40th St., New York City
Keasbey & Mattison Co., Ambler, Pa.
Manhattan Rubber Mfg. Div., The, of Raybestos-Manhattan, Inc., Passaic, N. J.
Ruberoid Co., 500 5th Ave., New York City
Schundler, F. E., Co., Joliet, Ill.
Standard Asbestos Mfg. & Insulating Co., Kansas City, Mo.
Sullivan Co., The, Memphis, Tenn.
Union Asbestos & Rubber Co., Cicero, Ill.
Vermiculite Products Co., Houston, Tex.

INSULATION—Boiler:
Asbestos & Engineering Products, Ltd., London, England
Baldwin-Hill Co., Trenton, N. J.
Bird-Archer Co., Wrigley Bldg., Chicago, Ill.
Botfield Refractories Co., 776 S. Swanson St., Philadelphia, Pa.
Carey, Philip, Mfg. Co., The, Cincinnati, Ohio
Consolidated Expanded Metal Co., Wheeling, W. Va.
Dicalite Co., The, 120 Wall St., New York City
Eagle-Picher Lead Co., The, Cincinnati, Ohio
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Forty Eight Insulations, Inc., North Aurora, Ill.
Johns-Manville Corp., 22 E. 40th St., New York City
Lucey Boiler & Mfg. Co., Chattanooga, Tenn.
Mexico Refractories Co., Mexico, Mo.
Owens Corning Fiberglas Corp., Toledo, Ohio
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.
Quigley Co., Inc., 56 W. 45th St., New York City
Ruberoid Co., 500 5th Ave., New York City
Schundler, F. E., Co., Joliet, Ill.
Sullivan Co., The, Memphis, Tenn.
Tnemec Co., Inc., Kansas City, Mo.
Universal Zonolite Insulation Co., 135 S. La Salle, Chicago, Ill.
Vermiculite Products Co., Houston, Tex.
Wyodak Chemical Co., 4600 E. 71st St., Cleveland, Ohio

INSULATION—Cork:
Armstrong Cork Co., Lancaster, Pa.
Cork Insulation Co., Inc., 155 E. 44th St., New York City
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Standard Asbestos Mfg. & Insulating Co., Kansas City, Mo.
Vermiculite Products Co., Houston, Tex.

INSULATION—Fabricated Metals:
Aluminum Co. of America, 21st Floor Gulf Bldg., Pittsburgh, Pa.
Eagle-Picher Lead Co., The, Cincinnati, Ohio
Schundler, F. E., Co., Joliet, Ill.
Truscon Steel Co., Youngstown, Ohio
Vermiculite Products Co., Houston, Tex.

INSULATION—Low-Temperature:
Armstrong Cork Co., Lancaster, Pa.
Baldwin-Hill Co., Trenton, N. J.
Carey, Philip, Mfg. Co., The, Cincinnati, Ohio
Dry Zero Corp., Merchandise Mart, Chicago, Ill.
Eagle-Picher Lead Co., The, Cincinnati, Ohio
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Forty Eight Insulations, Inc., North Aurora, Ill.
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Johns-Manville Corp., 22 E. 40th St., New York City
Laclede Christy Clay Products Co., St. Louis, Mo.
Mundet Cork Corp., Brooklyn, N. Y.
National Engineering Products, Inc., 4100 Georgia Ave., Washington, D. C.
Owens Corning Fiberglass Corp., Toledo, Ohio
Ruberoid Co., 500 5th Ave., New York City
Schundler, F. E., Co., Joliet, Ill.
Standard Asbestos Mfg. & Insulating Co., Kansas City, Mo.
Sullivan Co., The, Memphis, Tenn.
Universal Zonolite Insulation Co., 135 S. La Salle, Chicago, Ill.
Vermiculite Products Co., Houston, Tex.
Wyodak Chemical Co., 4600 E. 71st St., Cleveland, Ohio

INSULATION—Rock Wool:
Baldwin-Hill Co., Trenton, N. J.
Bird-Archer Co., Wrigley Bldg., Chicago, Ill.
Carey, Philip, Mfg. Co., The, Cincinnati, Ohio
Eagle-Picher Lead Co., The, Cincinnati, Ohio
Ehret Magnasia Mfg. Co., Valley Forge, Pa.
Forty Eight Insulations, Inc., North Aurora, Ill.
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Johns-Manville Corp., 22 E. 40th St., New York City
Keasbey & Mattison Co., Ambler, Pa.
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.
Refractory & Insulation Corp., 381 4th Ave., New York City
Ruberoid Co., 500 5th Ave., New York City
Schundler, F. E., Co., Joliet, Ill.
Standard Asbestos Mfg. & Insulating Co., Kansas City, Mo.
Vermiculite Products Co., Houston, Tex.

INSULATION—Tanks:
Asbestos & Engineering Products, Ltd., London, England
Armstrong Cork. Co., Lancaster, Pa.
Baldwin-Hill Co., Trenton, N. J.
Botfield Refractories Co., 776 S. Swanson St., Philadelphia, Pa.
Eagle-Picher Lead Co., The, Cincinnati, Ohio
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Forty Eight Insulations, Inc., North Aurora, Ill.
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Johns-Manville Corp., 22 E. 40th St., New York City
Mundet Cork Corp., Brooklyn, N. Y.
Owens Corning Fiberglas Corp., Toledo, Ohio
Schundler, F. E., Co., Joliet, Ill.
Self-Vulcanizing Co., 605 W. Washington, Chicago, Ill.
Sullivan Co., The, Memphis, Tenn.
Tank Seal Products Co., Tulsa, Okla.
Universal Zonolite Insulation Co., 135 S. La Salle, Chicago, Ill.
Vermiculite Products Co., Houston, Tex.

INTERCHANGERS—Heat—See HEAT EXCHANGERS:

ISOMERIZATION, Catalytic—See PROCESSES, Refining:

JETS—Ejector-Type:
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Continental-Diamond Fibre Co., Bridgeport, Pa.
Croll-Reynolds Engineering Co., 17 John St., New York City
Elliott Co., Jeannette, Pa.
Nathan Mfg. Co., 416 E. 106th St., New York City

JETS—Steam:
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Continental-Diamond Fibre Co., Bridgeport, Pa.
Croll-Reynolds Engineering Co., 17 John St., Chicago, Ill.
Elliott Co., Jeannette, Pa.
Foster Wheeler Corp., 165 Broadway, New York City
Haveg Corp., Newark, Del.
Jarecki Mfg. Co., St. Louis, Mo.
National Supply Co., Toledo, Ohio
Schutte & Koerting Co., 1116 Thompson St., Philadelphia, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

JOINTS—Expansion:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American District Steam Co., North Tonawanda, N. Y.
Badger, E. B., & Sons Co., 75 Pitts St., Expansion Joint Div., Boston, Mass.
Belfield, H., Co., Philadelphia, Pa.
Carey, Philip, Mfg. Co., The, Cincinnati, Ohio
Chase Brass & Copper Co., Waterbury, Conn.
Chiksan Tool Co., Brea, Calif.
Clow, James B., & Sons, 201 N. Talman, Chicago, Ill.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Croll-Reynolds Engineering Co., 17 John St., New York City
Dresser Mfg. Co., Bradford, Pa.
Foster Wheeler Corp., 165 Broadway, New York City
Graver Tank & Mfg. Co., 4809 Todd, East Chicago, Ind.
Jarecki Mfg. Co., St. Louis, Mo.
National Valve & Mfg. Co., 3101 Liberty Ave., Pittsburgh, Pa.
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Southwest Welding & Mfg. Co., Alhambra, Calif.

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Zallea Bros. & Johnson, 816 Locust St., Wilmington, Del.

JOINTS—Flexible Ball:
Barco Mfg. Co., Chicago, Ill.
Cast Iron Pipe Research Assn, 122 S. Michigan, Chicago, Ill.
Clow, James B., & Sons, 201 N. Talman, Chicago, Ill.
Morrison Brothers, Dubuque, Iowa
Oil Equipment Mfg. Co., Louisville, Ky.
Spicer Manufacturing Co., Toledo, Ohio
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JOINTS—Swing:
Belfield, H., Co., Philadelphia, Pa.
Chiksan Tool Co., Brea, Calif.
Lunkenheimer Co., The, Cincinnati, Ohio
Maloney Tank Mfg. Co., Tulsa, Okla.
McDonald, A. Y., Mfg. Co., Dubuque, Iowa
Morrison Brothers, Dubuque, Iowa
Mueller Co., Decatur, Ill.
Oil Equipment Mfg. Co., Louisville, Ky.
Shand & Jurs Co., Berkeley, Calif.
Staytite Co., The, Houston, Tex.
Trerice, H. O. Co., Detroit, Mich.
Vapor Recovery Systems Co., The, Compton, Calif.
Walworth Co., 60 E. 42nd St., New York City
Wheaton, A. W., Brass Works, Newark, N. J.
Wyatt Metal & Boiler Works, Houston, Tex.

JOINTS—Swivel:
Barco Mfg. Co., Chicago, Ill.
Chiksan Tool Co., Brea, Calif.
McDonald, A. Y., Mfg. Co., Dubuque, Iowa
Trerice, H. O., Co., Detroit, Mich.

KETTLES—Compounding:
Aluminum Co. of America, 21st Floor Gulf Bldg., Pittsburgh, Pa.
American Steel Works, Kansas City, Mo.
Biggs Boiler Works, The, Akron, Ohio
Birmingham Tank Co., Birmingham, Ala.
Blickman, S., Inc., Weehawken, N. J.
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
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Hendrick Mfg. Co., Carbondale, Pa.
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Patterson-Kelley Co., Inc., The, East Stroudsburg, Pa.
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Sowers Mfg. Co., Buffalo, N. Y.
Standard Steel Corp., Los Angeles, Calif.
Struthers-Wells, Warren, Pa.

KETTLES—Grease:
American Steel Works, Kansas City, Mo.
Bethlehem Foundry & Machine Co., Bethlehem, Pa.
Biggs Boiler Works, The, Akron, Ohio
Birmingham Tank Co., Birmingham, Ala.
Blaw-Knox Co., Blawnox, Pa.
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Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Hendrick Mfg. Co., Carbondale, Pa.
Patterson Foundry & Machine Co., The, East Liverpool, Ohio
Patterson-Kelley Co., Inc., The, East Stroudsburg, Pa.
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American Steel Works, Kansas City, Mo.
Bethlehem Foundry & Machine Co., Bethlehem, Pa.
Biggs Boiler Works, The, Akron, Ohio.
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Blickman, S., Inc., Weehawken, N. J.
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
J. P. Devine Mfg. Co., Inc., Mount Vernon, Ill.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Graver Tank & Mfg. Co., 4809 Todd, East Chicago, Ill.
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Patterson Foundry & Machine Co., The, East Liverpool, Ohio
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Elgin Softener Corp., Elgin, Ill.
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Norton Co., Worcester, Mass.
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Precision Scientific Co., 1750 N. Springfield Ave., Chicago, Ill.
Refinery Supply Co., Tulsa, Okla.
S-M & Co., Houston, Tex.
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Taylor Instrument Companies, Rochester N. Y.
Tech Laboratories, Jersey City, N. J.
Trerice, H. O., Co., Detroit, Mich.
Waukesha Motor Co., Waukesha, Wis.

LABORATORY GLASSWARE:
Carborundum Co., Niagara Falls, N. Y.
Corning Glass Works, Corning, N. Y.
Greiner, Emil, Co., 55 Van Dam St., New York City
Kimble Glass Co., Vineland, N. J.
Podbielniak Centrifugal Super-Contactor Co., 8312 S. Chicago, Chicago, Ill.
Refinery Supply Co., Tulsa, Okla.
Schaar & Co., 754 W. Lexington, Chicago Ill.
Tagliabue, C. J., Mfg. Co., Brooklyn, N. Y.
Trerice, H. O., Co., Detroit, Mich.

LABORATORY SINKS—See SINKS, Acidproof:

LANTERNS—Electric:
Boyer-Campbell Co., 6540 St. Antoine St., Detroit, Mich.
Burgess Battery Co., Freeport, Ill.
Delta Electric Co., Marion, Ind.
Economy Electric Lantern Co., Milwaukee, Wis.
Industrial Products Co., 2828 N. 4th St., Philadelphia, Pa.
Justrite Mfg. Co., 2061 N. Southport Ave., Chicago, Ill.

LEATHER PACKING — See PACKING, Leather:

LEAVES—Filter—See FILTER LEAVES:

LINE BLINDS:
Hamer Oil Tool Co., Long Beach, Calif.
Shand & Jurs Co., Berkeley, Calif.

LININGS—Acidproof, Brick and Tile:
General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Goodrich, B. F., Co., Akron, Ohio
Harbison-Walker Refractories Co., Farmers Banks Bldg., Pittsburgh, Pa.
Haveg Corp., 919 N. Michigan, Chicago, Ill.
Haveg Corp., Newark, Del.
Knight, Maurice A., Akron, Ohio
Maintenance, Inc., Wooster, Ohio
Manhattan Rubber Mfg. Div. of Raybestos-Manhattan, Inc., Passaic, N. J.
Mexico Refractories Co., Mexico, Mo.
North American Refractories Co., Cleveland, Ohio
U. S. Stoneware Co., Akron, Ohio

LIGHTNING ARRESTORS — See ARRESTORS, Lightning:

LININGS—Corrosion-Resistant:
Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
Atlas Lumnite Cement Co., New York City
Bigelow-Liptak Corp., Detroit, Mich.
Bird-Archer Co., Wrigley Bldg., Chicago, Ill.
Blickman, S., Inc., Weehawken, N. J.
Continental-Diamond Fibre Co., Bridgeport, Pa.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodyear Tire & Rubber Co., Akron, Ohio
Haveg Corp., 919 N. Michigan, Chicago, Ill.
Haveg Corp., Newark, Del.
Klemp, Wm. F., Co., 6624 S. Melvina, Chicago, Ill.
Knight, Maurice A., Akron, Ohio
Laclede Christy Clay Products Co., St. Louis, Mo.
National Carbon Co., Inc., Cleveland, Ohio
National Lead Co., 111 Broadway, New York City
Oxley Engineering Co., Ltd., London, England
Pfaudler Co., The, Rochester, N. Y.
Saginaw Bearing Co., Saginaw, Mich.

Self-Vulcanizing Rubber Co., 605 W. Washington, Chicago, Ill.
Shenango-Penn Mold Co., Dover, Ohio
Steel Protection & Chemical Co., Inc. Mooresville, Ind.
Sullivan Co., The, Memphis, Tenn
Swan Laboratory, Elmira, N. Y.
U. S. Stoneware Co., Akron, Ohio
Watkins, Inc., Wichita, Kans.

LININGS—Furnace:

Atlas Lumnite Cement Co., New York City
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Bird-Archer Co., Wrigley Bldg., Chicago, Ill.
Furnace Economy Co., 201 N. Wells St., Chicago, Ill.
General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
Johns-Manville Corp., 22 E. 40th St., New York City
Kellogg Co., The M. W., 225 Broadway, New York City
Laclede Christy Clay Products Co., St. Louis, Mo.
Mexico Refractories Co., Mexico, Mo.
North American Refractories Co., Cleveland, Ohio
Norton Co., Worcester, Mass.
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.
Refractory & Insulation Corp., 381 4th Ave., New York City
Sullivan Co., The, Memphis, Tenn.
U. S. Stoneware Co., Akron, Ohio

LININGS—Refractory:

Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Biglow-Liptak Corp., Detroit, Mich.
Bird-Archer Co., Wrigley Bldg., Chicago, Ill.
Botfield Refractories Co., 776 S. Swanson St., Philadelphia, Pa.
Carborundum Co., Niagara Falls, N. Y.
Furnace Economy Co., 201 N. Wells St., Chicago, Ill.
General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
Johns-Manville Corp., 22 E. 40th St., New York City
Kellogg Co., The M. W., 225 Broadway, New York City
Klemp, Wm. F., Co., 6624 S. Melvina, Chicago, Ill.
Laclede Christy Clay Products Co., St. Louis, Mo.
Mexico Refractories Co., Mexico, Mo.
National Carbon Co., Inc., Cleveland, Ohio
North American Refractories Co., Cleveland, Ohio
Norton Co., Worcester, Mass.
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.
Quigley Co., Inc., New York City
Refractory & Insulation Corp., 381 4th Ave., New York City
Sullivan Co., The, Memphis, Tenn.
U. S. Stoneware Co., Akron, Ohio
Wellsville Fire Brick Co., Wellsville, Mo.

LIQUID LEVEL GAUGES—See GAUGES, Liquid Level:

LOCK NUTS—See NUTS, Lock:

LOCOMOTIVES—Industrial:

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General Electric Co., Schenectady, N. Y.
Jeffrey Mfg. Co., The, Columbus, Ohio
Porter, H. K., Co., Inc., Pittsburgh, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Whitcomb Locomotive Co., The, subsidiary of Baldwin Locomotive Co., Rochelle, Ill.

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Lunkenheimer Co., The, Cincinnati, Ohio
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Manzel Brothers Co., Buffalo, N. Y.
Nathan Mfg. Co., 416 E. 106th St., New York City
Newman, Hender & Co., Ltd., Woodchester, England
Noera Mfg. Co., Division, Waterbury, Conn.
Powell, Wm., Co., The, Cincinnati, Ohio
Swift Lubricator Co., Elmira, N. Y.
Torrington Mfg. Co., Inc., The, Torrington, Conn.

LUBRICATORS—Sight Feed:
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Detroit Lubricator, 5900 Trumbull Ave., Detroit, Mich.
Hills-McCanna, 2349 Nelson, Chicago, Ill.
Lunkenheimer Co., The, Cincinnati, Ohio
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Manzel Bros. Co., Buffalo, N. Y.
Nathan Mfg. Co., 416 E. 106th St., New York City
Newman, Hender & Co., Ltd., Woodchester, England
Nugent, Wm. W., Co., 410 N. Hermitage, Chicago, Ill.
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich.
Powell, Wm., Co., The, Cincinnati, Ohio
Swift Lubricator Co., Elmira, N. Y.

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MACHINES — Pipe-Cleaning — See PIPE CLEANING MACHINES:

MACHINES—Pipe Cutting & Threading—See THREADING & CUTTING MACHINES:

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Apollo Magneto Corp., Kingston, N. Y.
Edison-Splitdorf Corp., West Orange, N. J.
Eisemann Magneto Corp., 60 E. 42nd St., New York City
Fairbanks, Morse Co., 600 S. Michigan Ave., Chicago, Ill.
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Lenape Hydraulic Pressing & Forging Co., West Chester, Pa.
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Stacey Mfg. Co., The, Cincinnati, Ohio
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Vapor Recovery Systems Co., The, Compton, Calif.
Weber Engine Works, Kansas City, Mo.
Wyatt Metal & Boiler Works, Houston, Tex.

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Corning Glass Works, Corning, N. Y.
Hays, A. M., Corp., Michigan City, Ind.
King Engineering Corp., Ann Arbor, Mich.
Meriam Co., The, Cleveland, Ohio
Refinery Supply Co., Tulsa, Okla.
Republic Flow Meters Co., Chicago, Ill.
Simplex Valve & Meter Co., 68th and Upland Sts., Philadelphia, Pa.
Trerice, H. O., Co., Detroit, Mich.
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Connelly Iron Sponge & Governor Co., 3154 S. California, Chicago, Ill.
Meriam Co., The, Cleveland, Ohio
Refinery Supply Co., Tulsa, Okla.
Republic Flow Meters Co., Chicago, Ill.
Simplex Valve & Meter Co., 68th and Upland Sts., Philadelphia, Pa.
Trerice, H. O., Co., Detroit, Mich.

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Boyer-Campbell Co., St. Antoine St., Detroit, Mich.
Bullard, E. D., Co., 275 8th St., San Francisco, Calif.
Davis Emergency Equipment Co., Inc., Newark, N. J.
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Greiner, Emil, Co., 55 Van Dam St., New York City
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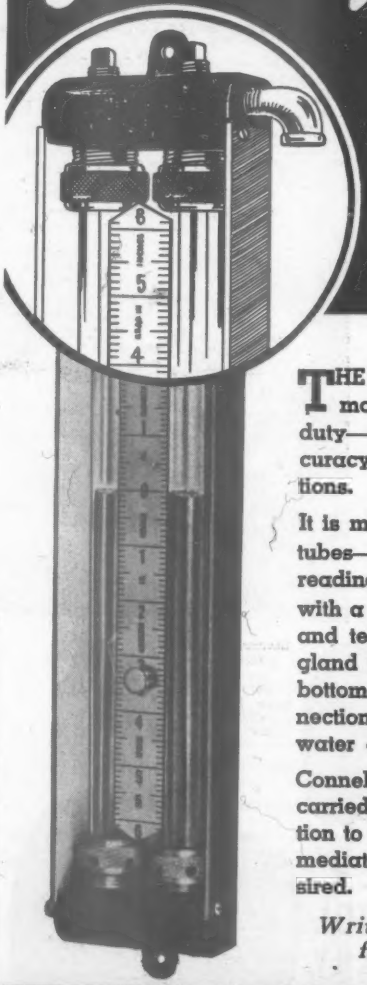

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Daniel Orifice Fitting Co., 3352 Union Pacific Ave., Los Angeles, Calif.
Foxboro Co., Foxboro, Mass
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
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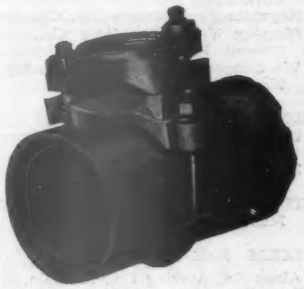

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Bristol Co., The, Waterbury, Conn.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
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Kent, George, Ltd., Luton, Bedfordshire, England
Mason-Neilan Regulator Co., Boston, Mass.
Meriam Co., The, Cleveland, Ohio
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Republic Flow Meters Co., Chicago, Ill.,

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Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Foxboro Co., Foxboro, Mass.
Hays, A. M., Corp., Michigan City, Ind.
Henzzey Co., Watertown, Wis.
Kent, George, Ltd., Luton, Bedfordshire, England
Mason Neilan Regulator Co., Boston, Mass.
Neptune Meter Co., 50 W. 50th St., New York City
Republic Flow Meters Co., Chicago, Ill.
Simplex Valve & Meter Co., 68th and Upland, Philadelphia, Pa.

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Bristol Co., The, Waterbury, Conn.
Esterline Angus Co., Indianapolis, Ind.
Foxboro Co., Foxboro, Mass.
General Electric Co., Schenectady, N. Y.
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Simplex Valve & Meter Co., 68th and Upland, Philadelphia, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Weston Electrical Instrument Corp., Newark, N. J.

METERS—Flow:
American District Steam Co., North Tonawanda, N. Y.
American Meter Co., 60 East 42nd St., New York City
American Recording Chart Co., 3113 E. 11th St., Los Angeles, Calif.
Bailey Meter Co., 1038 Ivanhoe Road, Cleveland, Ohio
Bowser, S. F., & Co., Inc., Fort Wayne, Ind.
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Mason Neilan Regulator Co., Boston, Mass.
Meriam Co., The, 1955 W. 112th St., Cleveland, Ohio
Moore Products Co., Philadelphia, Pa.
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Republic Flow Meters Co., Chicago, Ill.
Simplex Valve & Meter Co., 68th and Upland, Philadelphia, Pa.
Tagliabue, C. J., Mfg. Co., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.

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American Meter Co., 60 East 42nd St., New York City
American Recording Chart Co., 3113 E. 11th St., Los Angeles, Calif.
Bailey Meter Co., 1038 Ivanhoe Road, Cleveland, Ohio
Bristol Co., The, Waterbury, Conn.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Burke, Edmund, Engineering Co., 600 S. Michigan, Chicago, Ill.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Fischer & Porter Co., Hatboro, Pa.
Foxboro Co., Foxboro, Mass.
Kent, George, Ltd., Luton, Bedfordshire, England
Mason Neilan Regulator Co., Boston, Mass.
Meriam Co., The 1955 W. 112th St., Cleveland, Ohio
Moore Products Co., Philadelphia, Pa.
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Republic Flow Meters Co., Chicago, Ill.
Simplex Valve & Meter Co., 68th and Upland, Philadelphia, Pa.
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Buffalo Meter Co., Buffalo, N. Y.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Fischer & Porter Co., Hatboro, Pa.
Kent, George, Ltd., Luton, Bedfordshire, England
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Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Simplex Valve & Meter Co., 68th and Upland, Philadelphia, Pa.
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METERS—Gas, Positive-Displacement Type:
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Foxboro Co., Foxboro, Mass
Kent, George, Ltd., Luton, Bedfordshire, England
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Roots Connersville Blower Co., Connersville, Ind.
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Sprague Meter Co., Bridgeport, Conn.

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Neptune Meter Co., 50 W. 50th St., New York City
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American Meter Co., 60 East 42nd St., New York City
American Recording Chart Co., 3113 E. 11th St., Los Angeles, Calif.
Bailey Meter Co., 1038 Ivanhoe Road, Cleveland, Ohio
Bristol Co., The, Waterbury, Conn.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Fischer & Porter Co., Hatboro, Pa.
Foxboro Co., Foxboro, Mass.
Henzzey Co., Watertown, Wis.
Kent, George, Ltd., Luton, Bedfordshire, England
Mason Neilan Regulator Co., Boston, Mass.
Meriam Co., The, 1955 W. 112th St., Cleveland, Ohio
Moore Products Co., Philadelphia, Pa.
National Technical Laboratories, South Pasadena, Calif.
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Republic Flow Meters Co., Chicago, Ill.
Simplex Valve & Meter Co., 68th and Upland, Philadelphia, Pa.
Tagliabue, C. J., Mfg. Co., Brooklyn, N. Y.

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National Technical Laboratories, South Pasadena, Calif.

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Cochrane Corp., 17th and Allegheny Ave. Philadelphia, Pa.
Fischer & Porter Co., Hatboro, Pa.
Foxboro Co., Foxboro, Mass.

METERS—Water:
Bailey Meter Co., 1038 Ivanhoe Road, Cleveland Ohio
Buffalo Meter Co., Buffalo, N. Y.
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Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Fischer & Porter Co., Hatboro, Pa.
Foxboro Co., Foxboro, Mass.
Henzzey Co., Watertown, Wis.
Kent, George, Ltd., Luton, Bedfordshire, England
Meriam Co. The, 1955 W. 112th St., Cleveland, Ohio
Moore Products Co., Philadelphia, Pa.
Neptune Meter Co., 50 W. 50th St., New York City
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Duriron Co., The, Inc., Dayton, Ohio
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Mixing Equipment Co., Inc., Rochester, N. Y.
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MIXERS—Continuous:
Mixing Equipment Co., Inc., Rochester, N. Y.

MIXERS—Doctor Treating—See MIXERS, Propeller Type:

MIXERS—Gasoline—See MIXERS, Propeller Type:

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Eastern Engr. Co., New Haven, Conn.
Mixing Equipment Co., Inc., Rochester, N. Y.
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Patterson-Kelley Co., Inc., The, East Stroudsburg, Pa.
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Patterson Foundry & Machine Co., The, East Liverpool, Ohio
Patterson-Kelley Co., Inc., The, East Stroudsburg, Pa.

Porter, H. K., Co., Inc. Pittsburgh, Pa.
Stratford Engineering Corp., Kansas City, Mo.
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Dorr Co., Inc., 570 Lexington Ave., New York City
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Edge Moor Iron Works, Inc., 30 Rockefeller Plaza, New York City
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MIXING NOZZLES—See NOZZLES, Mixing:

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Laclede Christy Clay Products Co., St. Louis, Mo.
Mexico Refractories Co., Mexico, Mo.
North American Refractories Co., Cleveland, Ohio
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.
Quigley Co., New York City
Refractory & Insulation Corp. 381 4th Ave., New York City
Sullivan Co., The, Memphis, Tenn.
U. S. Stoneware Co., Akron, Ohio

MORTAR—High-Temperature, Refractory:
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Botfield Refractories Co., 776 S. Swanson St., Philadelphia, Pa.
General Refractories Co., 1600 Real Estate Trust Bldg. Pittsburgh, Pa.
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
Johns-Manville Corp., 22 E. 40th St., New York City
Laclede Christy Clay Products Co., St. Louis, Mo.
Mexico Refractories Co., Mexico, Mo.
North American Refractories Co., Cleveland, Ohio
Plibrico Jointless Firebrick Co., 1800 N. Kingsbury, Chicago, Ill.
Refractory & Insulation Corp. 381 Fourth Ave., New York City
Sullivan Co., The, Memphis, Tenn.
U. S. Stoneware Co., Akron, Ohio

MOTOR-STARTING SWITCHES — See SWITCHES, Motor-Starting:

MOTORS—Air:
Airetool Mfg. Co., Springfield, Ohio
Chicago Pneumatic Tool Co., 6 E. 44th St., New York City
Ingersoll-Rand Co., 11 Broadway, New York City
Key Co., East St. Louis Ill.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Wilson, Thomas C., Inc., Long Island City, N. Y.

MOTORS—Electric, 1-Hp. and Larger:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Allis, Louis, Co., The, Milwaukee Wis.
Century Electric Co., St. Louis, Mo.
Continental Electric Co., 335 Ferry St., Newark, N. J.

Continental

MOTORS and GENERATORS

CONTINENTAL Motors are used in Refineries on five continents.

1 to 600 H. P.

Adjustable Speed, Explosion Proof, Splash Proof, and Gear Motors.

Converters, Dynamotors, Generators, and Motor Generator Sets. There are CONTINENTAL designs for every service.

CONTINENTAL ELECTRIC CO., INC.
335 FERRY ST., NEWARK, N. J.
Factories:
Newark, N. J. and Rockford, Ill.

Crocker-Wheeler Electric Mfg. Co., Ampere, N. J.
Electric Machinery Mfg. Co., Minneapolis, Minn.
Elliott Co., Jeannette, Pa.
Fairbanks, Morse Co., 600 S. Michigan Ave. Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Harnischfeger Corp., Milwaukee, Wis.
Ideal Electric & Mfg. Co., Mansfield, Ohio
Master Electric Co., Dayton, Ohio
Newman Industries, Ltd., Bristol, England
Robbins & Myers, Inc., Springfield, Ohio
Sturtevant B. F., Hyde Park, Boston, Mass.
Wagner Electric Corp., St. Louis, Mo.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MOTORS—Electric, Fractional Horsepower:
Century Electric Co., St. Louis, Mo.
General Electric Co., Schenectady, N. Y.
Master Electric Co., Dayton, Ohio
Newman Industries, Ltd., Bristol, England
Pioneer Gen-E-Motor Corp. 466 W. Superior, Chicago, Ill.
Robbins & Myers, Inc., Springfield, Ohio
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.
Speedway Mfg. Co., Cicero, Ill.
Wagner Electric Corp., St. Louis, Mo.
Westinghouse Electric & Mfg. Co. East Pittsburgh, Pa.

MOTORS—Explosion Proof:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Allis, Louis, Co., The, Milwaukee, Wis.
Century Electric Co., St. Louis, Mo.
Continental Electric Co., 335 Ferry St., Newark, N. J.
Crocker-Wheeler Electric Mfg. Co., Ampere, N. J.
Fairbanks Morse Co., 600 S. Michigan Ave., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Harnischfeger Corp., Milwaukee, Wis.
Ideal Electric & Mfg. Co., Mansfield, Ohio
Master Electric Co., Dayton, Ohio
Wagner Electric Corp., St. Louis, Mo.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MOTORS—Splashproof:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Allis, Louis, Co., The, Milwaukee, Wis.
Century Electric Co., St. Louis, Mo.
Continental Electric Co., 335 Ferry St., Newark, N. J.
Crocker-Wheeler Electric Mfg. Co., Ampere, N. J.
Fairbanks, Morse Co., 600 S. Michigan Ave., Chicago, Ill.
General Electric Co., Schenectady N. Y
Harnischfeger Corp., Milwaukee, Wis.
Ideal Electric & Mfg. Co., Mansfield, Ohio
Master Electric Co., Dayton, Ohio
Newman Industries, Ltd., Bristol, England
Robbins & Myers, Inc., Springfield, Ohio
Wagner Electric Corp., St. Louis Mo.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MOTORS—Submersible:
Byron Jackson Co., Pump Div., Los Angeles, Calif.

MOTORS—Totally Enclosed:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Allis, Louis, Co., The, Milwaukee, Wis.
Century Electric Co. St. Louis, Mo.
Continental Electric Co., 335 Ferry St., Newark, N. J.
Elliott Co., Jeannette, Pa.
Fairbanks, Morse Co., 600 S. Michigan Ave., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Harnischfeger Corp., Milwaukee, Wis.
Ideal Electric & Mfg. Co., Mansfield, Ohio
Master Electric Co., Dayton, Ohio
Newman Industries Ltd., Bristol, England
Robbins & Myers, Inc., Springfield, Ohio
Wagner Electric Corp., St. Louis, Mo.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MUFFLERS — Exhaust — See SILENCERS, Exhaust:

MULTIPLE V-BELTS—See BELTS, Multiple-V:

NATURAL GAS POLYMERIZATION—See PROCESSES, Refinery:

NECKS—Welding:
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Grinnell Co., Inc. Providence, R. I.
Lenape Hydraulic Pressing & Forging Co., West Chester, Pa.
Limbert, George B., Co., 570 Fulton, Chicago, Ill.
Midwest Piping & Supply Co., St. Louis, Mo.
Taylor Forge & Pipe Works, Chicago, Ill.
Texas Pipe Bending Co., Houston, Tex.
Walworth Co. 60 E. 42nd St., New York City

NONSPARKING TOOLS—See TOOLS, Nonsparking, Safety:

NOZZLES—Mixing:
Duriron Co., The, Inc., Dayton, Ohio
Haveg Corp., Newark, Del.
Spray Engineering Co., Somerville, Mass.

NOZZLES—Spray:
Chain Belt Co., Milwaukee, Wis.
Haveg Corp., Newark, Del.
Hudson Engineering Co. Houston, Tex.
Link-Belt Co., 300 W. Pershing Road, Indianapolis, Ind.
Marley Co., The, Kansas City, Kans.
National Airoil Burner Co., 1236 E. Sedgley Ave., Philadelphia, Pa.
Rockwood Sprinkler Co., Worcester, Mass.
Schubert-Christy Corp., Affton Station, St. Louis, Mo.
Schutte & Koerting Co., 1116 Thompson St., Philadelphia, Pa.
Spray Engineering Co., Somerville, Mass.
Spraying Systems Co., 4021 W. Lake, Chicago, Ill.
U. S. Stoneware Co., Akron, Ohio

Walker, W. L., Co., Tulsa, Okla.
Water Cooling Equipment Corp., St. Louis, Mo.
Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.

NOZZLES—Tank and Vessel, Forged-Steel:
Butane Equipment Co., Inc., Dallas, Tex.
Lenape Hydraulic Pressing & Forging Co., West Chester, Pa.
Maloney Tank Mfg. Co., Tulsa, Okla.
Staylite Co., The, Houston, Tex.
Taylor Forge & Pipe Works, Chicago, Ill.
Vapor Recovery Systems Co., The, Compton, Calif.

NUTS:
Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Nut & Bolt Co., Inc., Bridgeport, Conn.
Erie Bolt & Nut Co., Erie, Pa.
Hadfields Limited, London, Eng.
Lamson & Sessions Co., 1971 W. 85th St., Cleveland, Ohio
Oliver Iron & Steel Corp., 1001 Muriel St., Pittsburgh, Pa.
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
St. Louis Screw & Bolt Co., St. Louis, Mo.
Sheffield Steel Corp., Kansas City, Mo.
Standco Bolt Co., Houston, Tex.
Victor Products Corp., 2631 Belmont, Chicago, Ill.

NUTS—Alloy-Steel:
Bethlehem Steel Co., Bethlehem, Pa.
Duriron Co., The, Inc., Dayton, Ohio
Erie Bolt & Nut Co., Erie, Pa.
Hadfields Limited, London, Eng.
Lamson & Sessions Co., 1971 W. 85th St., Cleveland, Ohio
Ohio Steel Foundry Co., The, Springfield, Ohio
Oliver Iron & Steel Corp., 1001 Muriel St., Pittsburgh, Pa.
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
St. Louis Screw & Bolt Co., St. Louis, Mo.
Sheffield Steel Corp., Kansas City, Mo.
Standco Bolt Co., Houston, Texas
Victor Products Corp., 2631 Belmont, Chicago, Ill.

NUTS—Brass or Bronze:
Ampco Metals, Inc., Milwaukee, Wis.
Chase Brass & Copper Co., Waterbury, Conn.
Erie Bolt & Nut Co., Erie, Pa.
Gilbert Brass Foundry Co., St. Louis, Mo.
Saginaw Bearing Co., Saginaw, Mich.
St. Louis Screw & Bolt Co., St. Louis, Mo.
Victor Products Corp., 2631 Belmont, Chicago, Ill.

NUTS—Lock:
Automatic Nut Co., Inc., Lebanon, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Chase Brass & Copper Co., Waterbury, Conn.
Columbia Nut & Bolt Co., Inc., Bridgeport, Conn.
Elastic Stop Nut Corp., Union, N. J.
Erie Bolt & Nut Co., Erie, Pa.
Laminated Shim Co., Inc., Glenbrook, Conn.
Lamson & Sessions Co., 1971 W. 85th St., Cleveland, Ohio
Oliver Iron & Steel Corp., 1001 Muriel St., Pittsburgh, Pa.
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Security Metal Products, Inc., Saugatuck, Mich.
Standard Pressed Steel Co., Jenkintown, Philadelphia, Pa.

OIL BURNERS—See BURNERS, Oil:

OIL CUPS—See CUPS, Oil:

OIL METERS—See METERS, Oil:

OIL THIEFS—See THIEFS, Oil:

OIL PURIFIERS—See PURIFIERS, Oil:

OIL SEALS—See SEALS, Oil:

OIL TESTING INSTRUMENTS:
Greiner, Emil, Co., 55 Van Dam St., New York City
King Refrigeration Co., 1011 Jefferson Ave., Toledo, Ohio
Podbielniak Centrifugal Super-Contractor Co., 8312 S. Chicago, Chicago, Ill.
Precision Scientific Co., 1750 N. Springfield, Chicago, Ill.
Refinery Supply Co., Tulsa, Okla.
Schaar & Co., 754 W. Lexington, Chicago, Ill.
Spencer Lens Co., Buffalo, N. Y.
Standard Electric Time Co., Springfield, Mass.
Tagliabue, C. J., Mfg. Co., Brooklyn, N. J

OPTICAL PYROMETERS — See PYROMETERS:

ORIFICE FITTINGS:
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Daniel Orifice Fitting Co., 3352 Union Pacific Ave., Los Angeles, Calif.
Robinson Orifice Fitting Co., 1435 Santa Fe Ave., Los Angeles, Calif.
Taylor Instrument Companies, Rochester, N. Y.

ORIFICE FLANGES—See FLANGES, Orifice:

ORIFICE METERS—See METERS, Orifice:

ORIFICE PLATES — See ORIFICE FITTINGS:

ORIFICE PLATES:
American Meter Co., 60 East 42nd St., New York City
Bristol Co., The, Waterbury, Conn.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Daniel Orifice Fitting Co., 3352 Union Pacific Ave., Los Angeles, Calif.
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
Meriam Co., The, 1955 W. 112th St., Cleveland, Ohio
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Republic Flow Meters Co., Chicago, Ill.
Taylor Instrument Companies, Rochester, N. Y.

PACKING—Asbestos:
Belmont Packing & Rubber Co., Butler & Sepviva, Philadelphia, Pa.
British Belting & Asbestos, Ltd., Cleckheaton, Yorkshire, England
Carey, Philip, Mfg. Co., The, Cincinnati, Ohio
Carlyle Rubber Co., 64 Park Place, New York City
Cincinnati Rubber Mfg. Co., The, Norwood Sta., Cincinnati, Ohio
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Darcoid Co., Inc., 149 Sixth Ave., New York City
Durabla Mfg. Co., 114 Liberty St., New York City
Durametallic Co., Kalamazoo, Mich.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Felt Products Mfg. Co., Chicago, Ill.
Garlock Packing Co., Palmyra, N. Y.
Gatke Corp., 228 N. La Salle St., Chicago, Ill.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodyear Tire & Rubber Co., Akron, Ohio
Greene, Tweed & Co., 101 Park Ave., New York City
Hewitt Rubber Corp., Buffalo, N. Y.
Jenkins Brothers, 80 White St., New York City
Johns-Manville Corp., 22 E. 40th St., New York City
Keasbey & Mattison Co., Ambler, Pa.
Klinger, Richard, Ltd., Sidcup (Kent), England
Klingerit, Inc., 16 Hudson St., New York City
Linear Packing & Rubber Co., Inc., Philadelphia, Pa.
Manhattan Rubber Mfg. Div., Raybestos-Manhattan, Inc., Passaic, N. J.
Packing Engineering Corp., Cranford, N. J.
Quaker Rubber Corp., Wissinoming, Philadelphia, Pa.
Raybestos-Manhattan, Inc., Manheim, Pa.
Standard Asbestos Mfg. Co. & Insulating Co., Kansas City, Mo.
Thermoid Co., Trenton, N. J.
Union Asbestos & Rubber Co., Cicero, Ill.
U. S. Rubber Co., 1230 6th Ave., New York City
Vellumoid Co., Worcester, Mass.

PACKING—Cloth-Inserted:
Belmont Packing & Rubber Co., Butler & Sepviva, Philadelphia, Pa.
Carlyle Rubber Co., 64 Park Place, New York City
Cincinnati Rubber Mfg. Co., The, Norwood Sta., Cincinnati, Ohio
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Darcoid Co., Inc., 149 6th Ave., New York City
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Felt Products Mfg. Co., Chicago, Ill.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodrich, B. F., Co., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Greene, Tweed & Co., 101 Park Ave., New York City
Hewitt Rubber Corp., Buffalo, N. Y.
Jenkins Brothers, 80 White St., New York City
Johns-Manville Corp., 22 E. 40th St., New York City
Linear Packing & Rubber Co., Inc., Philadelphia, Pa.
Maloney Tank Mfg. Co., Tulsa, Okla.
Manhattan Rubber Mfg. Div., Raybestos-Manhattan, Inc., Passaic, N. J.
Quaker Rubber Corp., Wissinoming, Philadelphia, Pa.
Raybestos-Manhattan, Inc., Manheim, Pa.
Thermoid Co., Trenton, N. J.
U. S. Rubber Co., 1230 6th Ave., New York City

PACKING—Fibre:
Belmont Packing & Rubber Co., Butler & Sepviva, Philadelphia, Pa.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Darcoid Co., Inc., 149 6th Ave., New York City
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Felt Products Mfg. Co., Chicago, Ill.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Greene, Tweed & Co., 101 Park Ave., New York City
Johns-Manville Corp., 22 E. 40th St., New York City
Linear Packing & Rubber Co., Inc., Philadelphia, Pa.
Maloney, F. H., Co., Houston, Tex.
Quaker Rubber Corp., Wissinoming, Philadelphia, Pa.
Thermoid Co., Trenton, N. J.
U. S. Rubber Co., 1230 Sixth Ave., New York City
Vellumoid Co., Worcester, Mass.
Victor Mfg. & Gasket Co., 5750 W. Roosevelt Rd., Chicago, Ill.

PACKING—Hot-Oil Pump:
Belmont Packing & Rubber Co., Butler & Sepviva, Philadelphia, Pa.
Carlyle Rubber Co., 64 Park Place, New York City
Chicago Belting Co., 125 N. Green, Chicago, Ill.

Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Crowder, John H., Tulsa, Okla.

JOHN H. CROWDER
HOT OIL PACKINGS
FOR
Reciprocating and Centrifugal Pumps
Any Temperature —Any Pressure
John H. Crowder
Manufacturer of
Semi Metallic Packings
Box 3168 Whittier Sta.
Tulsa, Okla.

Darcoid Co., Inc., 149 Sixth Ave., New York City
Durabla Mfg. Co., 114 Liberty St., New York City
Durametallic Corp., Kalamazoo, Mich.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Felt Products Mfg. Co., Chicago, Ill.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Greene, Tweed & Co., 101 Park Ave., New York City
Johns-Manville Corp., 22 E. 40th St., New York City
Linear Packing & Rubber Co., Inc., Philadelphia, Pa.
Manhattan Rubber Mfg. Div., Raybestos-Manhattan, Inc., Passaic, N. J.
National Engineering Products Co., Inc., Washington, D. C.
Packing Engineering Corp., Cranford, N. J.
Quaker Rubber Corp., Wissinoming, Philadelphia, Pa.
Raybestos-Manhattan, Inc., Manheim, Pa.
Thermoid Co., Trenton, N. J.
U. S. Rubber Co., 1230 Sixth Ave., New York City

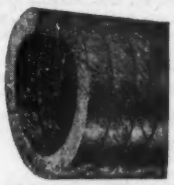
PACKING—Leather:
Alexander Brothers, Inc., 405 N. Third St., Philadelphia, Pa.
Auer, C. L. and W. W., Corry, Pa.
Chicago Belting Co., 125 N. Green, Chicago, Ill.
Durametallic Corp., Kalamazoo, Mich.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Excelsior Leather Washer Co., Rockford, Ill.
Felt Products Mfg. Co., Chicago, Ill.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Graton & Knight Mfg. Co., Worcester, Mass.
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Houghton, E. F., Co., Third, American and Somerset Sts., Philadelphia, Pa.
Preston, Horace G., Co., 2581 Beecher St., Detroit, Mich.
Rhoads, J. E., & Sons, 35 N. Sixth St., Philadelphia, Pa.
Schieren, Charles A., Co., 30 Ferry St., New York City

PACKING—Mechanical Seal—See SEALS, Oil:

PACKING—Metallic and Semimetallic:
Belmont Packing & Rubber Co., Butler & Sepviva, Philadelphia, Pa.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Cook, C. Lee, Mfg. Co., Inc., Louisville, Ky.
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.

JOHN CRANE PACKINGS *designed for* REFINERY SERVICES

Specify "JOHN CRANE" Packings—
and you receive the highest quality that fine materials, scientific manufacture and technical experience can produce. Such special design assures the "right" style for the "right" service and performance that is not only trouble-proof but most economical. More than 300 styles plus a 25-year-experience file are your assurance of solution.

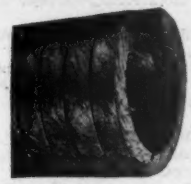


HOT OIL . . . Temp. to 1000°F.
Style 100-AL "JOHN CRANE" Cracking Pump Packing designed for centrifugal pumps is a semi-metallic style made of thin ribbons of soft-annealed aluminum foil spirally and loosely wrapped around a core of pure dry asbestos. "Micro'yne" dry graphite . . . Style 1011 recommended for plunger pumps.

GASOLINE . . . Temp. to 550°F.
Super-Seal # 3, "JOHN CRANE," Plastic Packing with tape backing is a general service style handling water, oil, gasoline. Made from long fibre asbestos, impregnated with special oil-proof binder thoroughly lubricated with purest dry graphite. Lubrication will not wash out. Tape backing prevents fracture while fitting around small shafts.

OILS, DISTILLATES, SOLVENTS.
Style 1810, "JOHN CRANE" Braided Asbestos Petroleum Resistant Packings on centrifugal, reciprocating and rotary pumps. Made from finest Canadian asbestos yarns by plaited-braid method. Each strand is treated; a soft resilient packing reducing friction to a minimum.

HOT OIL, and STEAM . . . Temp. to 550°F.
Style 804-D "JOHN CRANE" Oil-proof Asbestos Packing is designed for valve stems, expansion joints, pump rods and plungers. An oil-proof, Crane-prene treated braid-over-braid style made from finest long fibre asbestos yarn; each strand impregnated with special dry graphite.



CRUDE OIL . . . centrifugal pipe line pumps.
Style 100-MP "JOHN CRANE" Pipe Line Packing is designed for crude oil and distillates with temperatures to 450° F. at 800 pounds pressure. It is a flexible, compressible, all metallic packing made of continuous ribbons of soft babbitt foil, spirally and loosely wrapped, crinkled and folded. Each layer is lubricated with "Microfyne" dry graphite.

CRUDE OIL . . . centrifugal circulating pumps.
Style 110-MP "JOHN CRANE" Oil Pump Packing servicing crude oils, mineral oils and distillates to 450° F. at 400 pounds pressure. A new "JOHN CRANE" achievement. Flexible, semi-metallic soft babbitt foil packing with "Microfyne" graphite lubrication, not affected by gasoline or oil. Shaft sleeves polished to mirror smooth finish.

WATER, CAUSTIC, ACIDS . . .
Style 810 "JOHN CRANE" Universal Pump Packing for centrifugal and rotary pumps is a braided style of packing made of the finest Canadian asbestos yarn. High-flash-point lubricant and graphite impregnated into each strand.

HIGH PRESSURE STEAM.
Style 800 "JOHN CRANE" High Pressure Asbestos Packing (red rubber cushioned back) for high pressure steam and steam rods, compressors and pumps. Made of closely woven asbestos cloth, treated with heat resisting compound rolled and folded around non-hardened red rubber cushion, graphite coated.

Crane Packing Company, 1800 Cuyler Avenue, Chicago, Baltimore, Buffalo, Boston, Cleveland, Dallas, Detroit, Houston, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, San Francisco, St. Louis, Tulsa
Crane Packing Co., Ltd., Hamilton, Ontario, Canada, Montreal, Toronto, Vancouver

Crowder, John H., Tulsa, Okla.
Darcoid Co., Inc., 149 Sixth Ave., New York City
Durabla Mfg. Co., 114 Liberty St., New York City
Durametallic Corp., Kalamazoo, Mich.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Felt Products Mfg. Co., Chicago, Ill.
France Manufacturing Co., Belgrade St., Philadephia, Pa.
France Packing Co., Tacony, Philadelphia, Pa.
Garlock Packing Co., Palmyra, N. Y.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Johns-Manville Corp., 22 E. 40th St., New York City
Koppers Co., Koppers Bldg., Pittsburgh, Pa.
Linear Packing & Rubber, Inc., Philadelphia, Pa.
Manhattan Rubber Mfg. Div., Raybestos-Manhattan, Inc., Passaic, N. J.
Packing Engineering Corp., Cranford, N. J.
Quaker Rubber Corp., Wissinoming, Philadelphia, Pa.
Raybestos-Manhattan, Inc., Manheim, Pa.
U. S. Rubber Co., 1230 Sixth Ave., New York City

PACKING—Molded:
Acadia Synthetic Products Div., Western Felt Works, Chicago, Ill.
Belmont Packing & Rubber Co., Butler & Sepviva, Philadelphia, Pa.
Carlyle Rubber Co., 64 Park Place, New York City
Chicago Belting Co., 125 N. Green, Chicago, Ill.
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Crowder, John H., Tulsa, Okla.
Darcoid Co., Inc., 149 Sixth Ave., New York City
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodrich, B. F., Co., Akron, Ohio
Greene, Tweed & Co., 101 Park Ave., New York City
Johns-Manville Corp., 22 E. 40th St., New York City
Linear Packing & Rubber Co., Inc., Philadelphia, Pa.
Manhattan Rubber Mfg. Div., Raybestos-Manhattan, Inc., Passaic, N. J.
U. S. Rubber Co., 1230 Sixth Ave., New York City

PACKING—Plastic:
Acadia Synthetic Products Div., Western Felt Works, Chicago, Ill.
Continental-Diamond Fibre Co., Bridgeport, Pa.
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Durametallic Corp., Kalamazoo, Mich.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Formica Insulation Co., The, Cincinnati, Ohio
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Haveg Corp., Newark, Del.
Johns-Manville Corp., 22 E. 40th St., New York City
Maloney, F. H., Co., Houston, Tex.
National Engineering Products, Inc., Washington, D. C.
Packing Engineering Corp., Cranford, N. J.
Quaker Rubber Corp., Wissinoming, Philadelphia, Pa.
Raybestos-Manhattan, Inc., Manheim, Pa.
Reilly Tar & Chemical Co., Indianapolis, Ind.
U. S. Rubber Co., 1230 Sixth Ave., New York City
U. S. Stoneware Co., Akron, Ohio

PACKING—Rubber:
Acadia Synthetic Products Div., Western Felt Works, Chicago, Ill.
Belmont Packing & Rubber Co., Butler & Sepviva, Philadelphia, Pa.
Carlyle Rubber Co., 64 Park Place, New York City
Chicago Belting Co., 125 N. Green, Chicago, Ill.
Cincinnati Rubber Mfg. Co., The, Norwood Sta., Cincinnati, Ohio
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Darcoid Co., Inc., 149 Sixth Ave., New York City
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Felt Products Mfg. Co., Chicago, Ill.
Garlock Packing Co., Palmyra, N. Y.
General Tire & Rubber Co., Akron, Ohio
Goetze Gasket & Packing Co., New Brunswick, N. J.
Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.
Goodrich, B. F., Co., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Gustin-Bacon Mfg. Co., Kansas City, Mo.
Happy Co., The, Tulsa, Okla.
Hewitt Corp., Buffalo, N. Y.
Jenkins Brothers, 80 White St., New York City
Johns-Manville Corp., 22 E. 40th St., New York City
Linear Packing & Rubber Co., Inc., Philadelphia, Pa.
Maloney Tank Mfg. Co., Tulsa, Okla.
Manhattan Rubber Mfg. Div., Raybestos-Manhattan, Inc., Passaic, N. J.
New York Rubber Corp., 9 Rockefeller Plaza, New York City
Quaker Rubber Corp., Wissinoming, Philadelphia, Pa.
Raybestos-Manhattan, Inc., Manheim, Pa.
Republic Rubber Co., The, Youngstown, Ohio
Thermoid Co., Trenton, N. J.
U. S. Rubber Co., 1230 Sixth Ave., New York City
U. S. Stoneware Co., Akron, Ohio
Westinghouse Air Brake Co., Wilmerding, Pa.

PACKING—Sheet:
Belmont Packing & Rubber Co., Butler and Sepviva, Philadelphia, Pa.
Carlyle Rubber Co., 64 Place Place, New York City
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
Darcoid Co., Inc., 149 Sixth Ave., New York City
Durabla Mfg. Co., 114 Liberty St., New York City
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Felt Products Mfg. Co., Chicago, Ill.
Garlock Packing Co., Palmyra, N. Y.
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Klinger, Richard. Ltd., Sidcup (Kent), England
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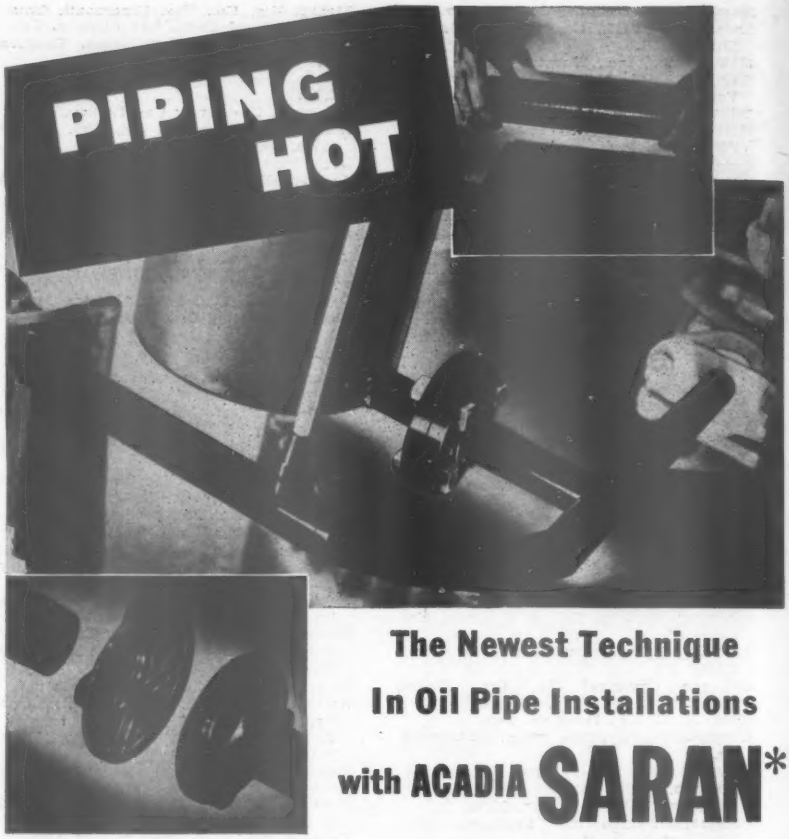

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Griscom-Russell Co., The, 285 Madison Ave., New York City
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Patterson Foundry & Machine Co., The, East Liverpool, Ohio
Patterson-Kelley Co., Inc., The, East Stroudsburg, Pa.
Petro-Chem Development Co., Inc., 120 E. 41st St., New York City
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Struthers-Wells, Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Zallea Bros. & Johnson, Wilmington, Del.

PRESSURE GAGES—See GAUGES, Pressure:

PRESSURE and VACUUM-RELIEF VALVES, Tank Vent:

PRESSURE REGULATORS — See REGULATORS, Pressure:

PRESSURE VESSELS—see VESSELS, Pressure:

PROCESSES—Clay-Treating Refinery:
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Attapulgus Clay Co., 260 S. Broad St., Philadelphia, Pa.
Filtrol Corp., 634 S. Spring St., Los Angeles, Calif.
Foster Wheeler Corp., 165 Broadway, New York City
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Gray Processes Corp., The, 26 Journal Square, Jersey City, N. J.
Hudson Engineering Co., Houston, Tex.
Kellogg Co., The M. W., 225 Broadway, New York City
Lummus Co., 420 Lexington Ave., New York City
McKee, Arthur G., & Co., Cleveland, Ohio
Westvaco Chlorine Products Corp., 135 E. 42nd St., New York City

PROCESSES, Alkylation—See PROCESSES, Refining:

PROCESSES ,Catalytic Desulfurization—See PROCESSES Desulfurization:

PROCESSES—Copper Sweetening:
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Foster Wheeler Corp., 165 Broadway, New York City
Lummus Co., The, 420 Lexington Ave., New York City
McKee, Arthur G., & Co., 2300 Chester Ave., Cleveland, Ohio
Phillips Petroleum Co., Perco Div., Bartlesville, Okla.

PROCESSES, Cracking—See PROCESSES, Refining:

PROCESSES—Desalting:
Petroleum Rectifying Co. of Calif., 530 W. 6th St., Los Angeles, Calif.

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Badger, E. B., & Sons Co., Boston, Mass.
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Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees, England
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Division Chemical Corp., The, Silica Gel Department, 20 Hopkins Place, Baltimore, Md.
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Petroleum Engineering, Inc., Tulsa, Okla.
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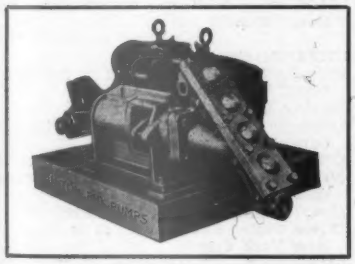

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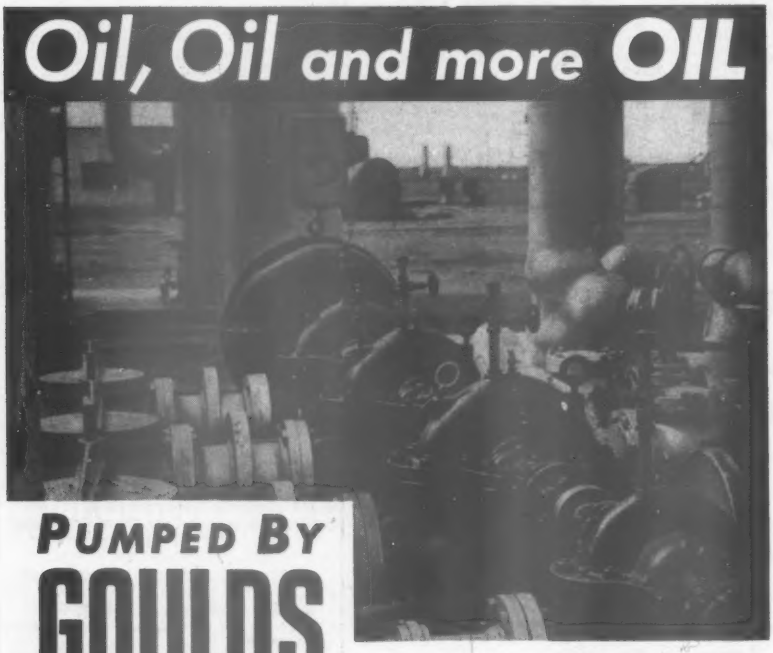
McCord Radiator & Mfg. Co., 2587 E. Grand, Detroit, Mich.
Manzel Bros. Co., Buffalo, N. Y.
Milton Roy Pumps, Chestnut Hill, Philadelphia, Pa.
Nash Engr. Co., South Norwalk, Conn.
National Carbon Co., Inc., Cleveland, Ohio
National Transit Pump & Machine Co. Oil City, Pa.
Oliver United Filters, Inc., 33 W. 42nd St., New York City
Patterson Foundry & Machine Co., The. East Liverpool, Ohio.
Pacific Pump Works, 5715 Bickett St., Huntington Park, Calif.
%Proportioneers, Inc.%, Providence, R. I.
Quimby Pump Co., Inc., Newark, N. J.
Roper, George D., Corp., Rockford, Ill.
Shriver & Co., T., Harrison, N. J.
Union Steam Pump Co., Battle Creek, Mich.
Wallace & Tiernan Co., Belleville, N. J.
Wheatley Brothers, Tulsa, Okla.
Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS—Clay Handling:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Manganese Steel Div., 389 E. 14th St., Chicago Heights, Ill.
Byron Jackson Co., P.O. Box 2017, Terminal Annex, Los Angeles, Calif.
Dayton Dowd Co., Quincy, Ill.
Fairbanks Morse Co., 600 S. Michigan Ave., Chicago, Ill.
Pacific Pump Works, 5715 Bickett St., Huntington Park, Calif.
Patterson Foundry & Machine Co., The. East Liverpool, Ohio.
Robbins & Myers, Inc., Springfield, Ohio
Shriver & Co., T., Harrison, N. J.
Union Steam Pump Co., Battle Creek, Mich.

PUMPS, Deep Well—See PUMPS, Turbine, Deep Well:

PUMPS—Diaphragm:
Barnes Manufacturing Co., Mansfield, Ohio
Deming Co., The, Salem, Ohio
Domestic Engine & Pump Co., Shippensburg, Pa.
Goulds Pumps, Inc., Seneca Falls, N. Y.
Newman, Hender & Co., Ltd., Woodchester, England
Novo Engine Co., Lansing, Mich.
Oliver United Filters, Inc., 33 W. 42nd St., New York City
Shriver & Co., T., Harrison, N. Y.
Wallace & Tiernan Co., Belleville, N. J.

PUMPS—Hot Oil:
American Manganese Steel Div., 389 E. 14th St., Chicago Heights, Ill.
American-Marsh Pumps, Inc., Battle Creek, Mich.
Aurora Pump Co., Aurora, Ill.
Blackmer Pump Co., Grand Rapids, Mich.
Byron Jackson Co., P.O. Box 2017, Terminal Annex, Los Angeles, Calif.
Dayton Dowd Co., Quincy, Ill.
Dean Brothers Pumps, Inc., Indianapolis, Ind.
Dean Hill Pump Co., Anderson, Ind.
DeLaval Steam Turbine Co., Trenton, N.J.
Deming Co., The, Salem, Ohio
Goulds Pumps, Inc., Seneca Falls, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York City
Lecourtenay Co., Newark, N. J.
Leyman Manufacturing Corp., Cincinnati, Ohio
National Airoil Burner Co., 1236 E. Sedgley Ave., Philadelphia, Penna.
National Steam Pump Co., Upper Sandusky, Ohio
National Transit Pump & Machine Co., Oil City, Pa.



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Roper, George D., Corp., Rockford, Ill.
Smith, A. O., Corp., Milwaukee, Wis.
Union Steam Pump Co., Battle Creek, Mich.
Weir, G. & J., Ltd., Glasgow, Scotland
Wilson-Snyder Mfg. Div. of Oil Well Supply Co., Braddock, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS—Plunger:
Aldrich Pump Co., Allentown, Pa.
American-Marsh Pumps, Inc., Battle Creek, Mich.
Barnes Manufacturing Co., Mansfield, Ohio
Dean Brothers Pumps, Inc., Indianapolis, Ind.
Deming Co., The, Salem, Ohio
Domestic Engine & Pump Co., Shippensburg, Pa.
Excelsior Leather Washer Co., Rockford, Ill.
Fairbanks Morse Co., 600 S. Michigan Ave., Chicago, Ill.
Gorman-Rupp Pump Co., Mansfield, Ohio
Goulds Pumps, Inc., Seneca Falls, N. Y.
Hills-McCanna, 2349 Nelson, Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City
Leyman Manufacturing Corp., Cincinnati, Ohio
Milton Roy Pumps, Chestnut Hill, Philadelphia, Pa.
National Steam Pump Co., Upper Sandusky, Ohio
National Transit Pump & Machine Co., Oil City, Pa.
Noera Mfg. Co., Division, Waterbury, Conn.
Novo Engine Co., Lansing, Mich.
Oil Well Supply Co., Dallas, Tex.
Prescott Co., The, Menominee, Mich.
%Proportioneers, Inc.%, Providence, R.I.
Union Steam Pump Co., Battle Creek, Mich.
Weir, G. & J., Ltd., Glasgow, Scotland
Wheland Co., Chattanooga, Tenn.
Wilson-Snyder Mfg. Div. of Oil Well Supply Co., Braddock, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

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Aldrich Pump Co., Allentown, Pa.
American-Marsh Pumps, Inc., Battle Creek, Mich.
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Fairbanks Morse Co., 600 S. Michigan Ave., Chicago, Ill.
Foster Pump Works, Inc., 50 Washington St., Brooklyn, N. Y.
Gardner-Denver Co., Quincy, Ill.
Gaso Pump & Burner Mfg. Co., Tulsa, Okla.
Goulds Pumps, Inc., Seneca Falls, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York City
Kinney Mfg. Co., 3529-41 Washington St., Boston, Mass.
Lawrence Pump & Engine Co., Lawrence, Mass.
Leyman Manufacturing Corp., Cincinnati, Ohio
National Steam Pump Co., Upper Sandusky, Ohio
National Supply Co., Toledo, Ohio
National Transit Pump & Machine Co., Oil City, Pa.
Novo Engine Co., Lansing, Mich.
Oil Well Supply Co., Dallas, Tex.
Roper, George D., Corp., Rockford, Ill
Sterling Machinery Corp., Kansas City, Mo.
Union Steam Pump Co., Battle Creek Mich.
Viking Pump Co., Cedar Falls, Iowa
Weir, G. & J., Ltd., Glasgow, Scotland
Wheatley Brothers, Tulsa, Okla.
Wheland Co., Chattanooga, Tenn.
Wilson-Snyder Mfg. Div. of Oil Well Supply Co., Braddock, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS—Proportioning:
Aldrich Pump Co., Allentown, Pa.
American-Marsh Pumps, Inc., Battle Creek, Mich.
Dearborn Chemical Co., 310 S. Michigan Ave., Chicago, Ill.
Elgin Softner Corp., Elgin, Ill.
Hills-McCanna, 2349 Nelson, Chicago, Ill.
International Filter Co., 325 W. 25th St Chicago, Ill.
Manzel Bros. Co., Buffalo, N. Y.
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Deming Co., The, Salem, Ohio
Fairbanks Morse Co., 600 S. Michigan Ave., Chicago, Ill.
Gardner-Denver Co., Quincy, Ill.
Gaso Pump & Burner Mfg. Co., Tulsa, Okla.
Goulds Pumps, Inc., Seneca Falls, N. Y.
Hills-McCanna, 2349 Nelson, Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City
Leyman Manufacturing Corp., Cincinnati, Ohio
Milton Roy Pumps, Chestnut Hill, Philadelphia, Pa.
National Steam Pump Co., Upper Sandusky, Ohio
National Transit Pump & Machine Co., Oil City, Pa.
Novo Engine Co., Lansing, Mich.
Oil Well Supply Co., Dallas, Tex.
Prescott Co., The, Menominee, Mich.
Weir, G. & J., Ltd., Glasgow, Scotland
Wheatley Brothers, Tulsa, Okla.
Wheland Co., Chattanooga, Tenn.
Wilson-Snyder Mfg. Div. of Oil Well Supply Co., Braddock, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

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Eastern Engr. Co., New Haven, Conn.
Fairbanks Morse Co., 600 S. Michigan Ave., Chicago, Ill.
Foster Pump Works, Inc., 50 Washington St., Brooklyn, N. Y.
Goulds Pumps, Inc., Seneca Falls, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York City
Kinney Mfg. Co., 3529-41 Washington St., Boston, Mass.
McDonald, A. Y. Mfg. Co., 12th and Pine Dubuque, Iowa.
Nash Engr. Co., South Norwalk, Conn.
National Transit Pump & Machine Co., Oil City, Pa.
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Prescott Co., The, Menominee, Mich.
Quimby Pump Co., Inc., Newark, N. J.
Robbins & Myers, Inc., Springfield, Ohio
Roper, George D., Corp., Rockford, Ill.
Viking Pump Co., Cedar Falls, Iowa
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Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS—Semirotary, Wing Type:
Newman, Hender & Co., Ltd., Woodchester, England

PUMPS—Screw:
Aurora Pump Co., Aurora, Ill.
Dayton Dowd Co., Quincy, Ill.
DeLaval Steam Turbine Co., Trenton, N. J.
Quimby Pump Co., Inc., Newark, N. J.
Watson-Stillman Co., Fitting Div., Roselle, N. J.

PUMPS—Submersible, Electric Centrifugal:
Allis-Chalmers Mfg. Co., Milwaukee, Wis
American Manganese Steel Div., 389 E. 14th St., Chicago Heights, Ill.
American-Marsh Pumps, Inc., Battle Creek, Mich.
Byron Jackson Co., P. O. Box 2017, Terminal Annex, Los Angeles, Calif.
Dean Hill Pump Co., Anderson, Ind.
DeLaval Steam Turbine Co., Trenton, N. J.
Goulds Pumps, Inc., Seneca Falls, N. Y.
Lawrence Pump & Engine Co., Lawrence, Mass.
Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS—Suction:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Manganese Steel Div., 389 E. 14th St., Chicago Heights, Ill.
American-Marsh Pumps, Inc., Battle Creek, Mich.
Aurora Pump Co., Aurora, Ill.
Barnes Manufacturing Co., Mansfield. Ohio
Chicago Pneumatic Tool Co., 6 E. 44th St., New York City.
Deming Co., The, Salem, Ohio
Gaso Pump & Burner Mfg. Co., Tulsa, Okla.
Goulds Pumps, Inc., Seneca Falls, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York City
Kinney Mfg. Co., 3529-41 Washington St Boston, Mass.
Leyman Manufacturing Corp., Cincinnati, Ohio
Nash Engr. Co., South Norwalk, Conn.
National Transit Pump & Machine Co. Oil City, Pa.
Noera Mfg. Co., Division, Waterbury, Conn.
Oil Well Supply Co., Dallas, Tex.
Pomona Pump Div. of Joshua Hendy Iron Works, Pomona, Calif.
Prescott Co., The, Menominee, Mich.
Roper, George D., Corp., Rockford, Ill
Sterling Machinery Corp., Kansas City, Mo.
Union Steam Pump Co., Battle Creek. Mich.
Viking Pump Co., Cedar Falls, Iowa
Weir, G. & J., Ltd., Glasgow, Scotland

PUMPS—Tar:
American Steam Pump Co., Battle Creek. Mich.
American-Marsh Pumps, Inc., Battle Creek, Mich.
Byron Jackson Co., P.O. Box 2017, Terminal Annex, Los Angeles, Calif.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Dean Brothers Pumps, Inc., Indianapolis, Ind.
Foster Pump Works, Inc., 50 Washington St., Brooklyn, N. Y.
Goulds Pumps, Inc., Seneca Falls, N. Y.
Kinney Mfg. Co., 3529-41 Washington St., Boston, Mass.
Leyman Manufacturing Corp., Cincinnati, Ohio
National Transit Pump & Machine Co., Oil City, Pa.
Noera Mfg. Co., Division, Waterbury, Conn.
Oil Well Supply Co., Dallas, Tex.
Quimby Pump Co., Inc., Newark, N. J.
Roots Connersville Blower Co., Connersville, Ind.
Roper, George D., Corp., Rockford, Ill.
Union Steam Pump Co., Battle Creek, Mich.
Viking Pump Co., Cedar Falls, Iowa
Weir, G. & J., Ltd., Glasgow, Scotland
Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS—Triplex:
Aldrich Pump Co., Allentown, Pa.
American-Marsh Pumps, Inc., Battle Creek, Mich.
Clark Bros. Co., Inc., Box 560, Olean, N.Y.
Dean Brothers Pumps, Inc., Indianapolis, Ind.
Deming Co., The, Salem, Ohio
Gorman-Rupp Pump Co., Mansfield. Ohio.
Goulds Pumps, Inc., Seneca Falls, N. Y.
National Transit Pump & Machine Co Oil City, Pa.
Oil Well Supply Co., Dallas, Tex.
Prescott Co., The, Menominee, Mich.
Union Steam Pump Co., Battle Creek. Mich.
Watson-Stillman Co., Fitting Div., Roselle, N. J.
Weir, G. & J., Ltd., Glasgow, Scotland
Wheatley Brothers, Tulsa, Okla.
Wilson-Snyder Mfg. Div. of Oil Well Supply Co., Braddock, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS—Turbine, Deep Well:
Allen, W. H., Sons & Co., Ltd., Bedford. England
American Well Works, Aurora, Ill.
Aurora Pump Co., Aurora, Ill.
Byron Jackson Co., P.O. Box 2017, Terminal Annex, Los Angeles, Calif.
Cook, A. D., Inc., Lawrenceburg, Ind.
Dayton Dowd Co., Quincy, Ill.
Deming Co., The, Salem, Ohio
Fairbanks Morse Co., 600 S. Michigan Ave., Chicago, Ill.
Layne & Bowler, Inc., Memphis, Tenn.
Pacific Pump Works, 5715 Bickett St., Huntington Park, Calif.
Peerless Pump Div. of Food Machinery Corp., Los Angeles, Calif.
Pomona Pump Div. of Joshua Hendy Iron Works, Pomona, Calif.
Weir, G. & J., Ltd., Glasgow, Scotland
Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS—Vacuum:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American-Marsh Pumps, Inc., Battle Creek, Mich.
Beach-Russ Co., 50 Church St., New York City
Bury Compressor Co., Erie, Pa.
Byron Jackson Co., P.O. Box 2017, Terminal Annex, Los Angeles, Calif.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York City.
Clark Bros. Co., Inc., Box 560, Olean, N.Y.
Croll-Reynolds Engineeering Co., 17 John St., New York City
Dean Brothers Pumps, Inc., Indianapolis, Ind.
Devine, J. P., Manufacturing Co., Mount Vernon, Ill.
Foster Pump Works, Inc., 50 Washington St., Brooklyn, N. Y.
Foster Wheeler Corp., 165 Broadway, New York City
Fuller Co., Catasauqua, Pa.
Gardner-Denver Co., Quincy, Ill.
Gaso Pump & Burner Mfg. Co., Tulsa, Okla.
Ingersoll-Rand Co., 11 Broadway, New York City
Kinney Mfg. Co., 3529-41 Washington St., Boston, Mass.
Leyman Manufacturing Corp., Cincinnati, Ohio
Nash Engr. Co., South Norwalk, Conn.
National Steam Pump Co., Upper Sandusky, Ohio
Patterson Foundry & Machine Co., The, East Liverpool, Ohio
Precision Scientific Co., 1750 N. Springfield Ave., Chicago, Ill.
Prescott Co., The, Menominee, Mich.
Roots Connersville Blower Co., Connersville, Ind.
Sullivan Machinery Co., Michigan City, Ind.
Tokheim Co., Cedar Rapids, Iowa
Union Steam Pump Co., Battle Creek. Mich.
Weir, G. & J., Ltd., Glasgow, Scotland
Worthington Pump & Machinery Corp., Harrison, N. J.

PURIFIERS—Oil:
Briggs Clarifier Co., 1339 Wisconsin St., Washington, D. C.
DeLaval Steam Turbine Co., Trenton, N.J.
De Luxe Products Corp., La Porte, Ind.
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Hilliard Crane Corp., 702 Indianapolis Ave., Lebanon, Ind.
Nugent, Wm. W., Co., 410 N. Hermitage. Chicago, Ill.
Petroleum Engineering, Inc., Tulsa, Okla.
Skinner Purifiers, Inc., 1349 East Milwaukee, Detroit, Mich.
Youngstown Miller Co., Sandusky, Ohio

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Cambridge Instrument Co., Inc., 3732 Grand Central Terminal, New York City
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Foxboro Co., Foxboro, Mass.
Kent, George, Ltd., Luton, Bedfordshire. England

Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Schaar & Co., 754 W. Lexington, Chicago, Ill.
Tagliabue, C. J., Mfg. Co., Brooklyn, N.Y
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

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Englehard, Charles, Inc., Newark, N. J.
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Norton Co., Worcester, Mass.
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RADIATOR SECTIONS:
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National Radiator Co., The, Johnston, Pa.
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RAILING FITTINGS—See FITTINGS, Railing:

RASHIG RINGS—See TOWER PACKING:

REAMERS—Pipe:
Armstrong Bros. Tool Co., 317 N. Francisco, Chicago, Ill.
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Mueller Co., Decatur, Ill.
Nye Tool and Machine Co., Chicago, Ill.
Ridge Tool Co., The, Elyria, Ohio
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American Locomotive Co., Alco Products Div., 30 Church St., New York City
Beaird Corp., J. B., Shreveport, La.
Condenser Service & Engr. Co., Inc., Hoboken, N J.
Coy Co., Jos. A., Inc., Tulsa, Okla.
Devine, J. P., Manufacturing Co, Mount Vernon, Ill
Engineers & Fabricators, Inc., Houston, Tex.
Foster Wheeler Corp., 165 Broadway, New York City
Griscom-Russell Co., The, 285 Madison Ave., New York City
Hudson Engineering Co., Houston, Tex.
National Carbon Co., Inc., Cleveland, Ohio
Patterson-Kelley Co., Inc., The, East Stroudsburg, Pa.
Petro-Chem Development Co., Inc., 120 E. 41st. St., New York City
Southwest Welding & Mfg. Co., Alhambra, Calif.
Southwestern Engineering Co., Los Angeles, Calif.
Standard Steel Corp., Los Angeles, Calif.
Tulsa Boiler & Machinery Co., Tulsa, Okla.

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Gordon, James & Co., Ltd., Stanmore, England
Hays, A. M., Corp., Michigan City, Ind.
Kent, George, Ltd., Luton, Bedfordshire, England
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Refinery Supply Co., Tulsa, Okla.
Republic Flow Meters Co., Chicago, Ill.

RECORDERS—Combustion:
Bailey Meter Co., 1038 Ivanhoe Road, Cleveland, Ohio
Bristol Co., The, Waterbury, Conn.
Foxboro Co., Foxboro, Mass.
Hayes, A. M., Corp., Michigan City, Ind.
Kent, George, Ltd., Luton, Bedfordshire, England

RECORDERS—Differential:
American Recording Chart Co., 3113 E. 11th St., Los Angeles, Calif.
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Bristol Co., The, Waterbury Conn.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Foxboro Co., Foxboro, Mass.
Hayes, A. M., Corp., Michigan, City, Ind
Mason Neilan Regulator Co., Boston, Mass.
Moore Products Co., Philadelphia, Pa.
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Republic Flow Meters Co., Chicago, Ill.
Simplex Valve & Meter Co., 68th and Upland, Philadelphia, Pa.
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RECORDERS—Electric:
American Automatic Electric Sales Co, 1033 W. Van Buren, Chicago, Ill.
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Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Esterline Angus Co., Indianapolis, Ind.
Foxboro Co., Foxboro, Mass.
General Electric Co., Schenectady, N. Y.
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Tagliabue, C. J., Mfg. Co., Brooklyn. N.Y

RECORDERS—Flow:
American Meter Co., 60 East 42nd St., New York City
Bailey Meter Co., 1038 Ivanhoe Road, Cleveland, Ohio
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Fischer & Porter Co., Hatboro, Pa.
Foxboro Co., Foxboro, Mass.
Henzzey Co., Watertown, Wis.
Kent, George, Ltd., Luton, Bedfordshire, England
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Mason Neilan Regulator Co., Boston, Mass
Moore Products Co., Philadelphia, Pa
Republic Flow Meters Co., Chicago, Ill.
Simplex Valve & Meter Co., 68th and Upland, Philadelphia, Pa.
Tagliabue, C. J., Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Companies, Rochester, N. Y.

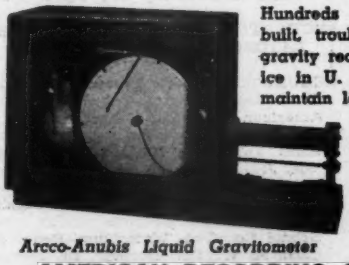
RECORDERS—Gravity:
American Meter Co., 60 East 42nd St., New York City
American Recording Chart Co., 3113 E. 11th St., Los Angeles, Calif.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Foxboro Co., Foxboro, Mass.
Kent, George, Ltd., Luton, Bedfordshire, England
Refinery Supply Co., Tulsa, Okla.
Republic Flow Meters Co., Chicago, Ill.

RECORDERS—Humidity:
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Cambridge Instrument Co., Inc., 3732 Grand Central Terminal, New York City
Foxboro Co., Foxboro, Mass.
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Mason Neilan Regulator Co., Boston, Mass.
Powers Regulator Co., 2720 Greenview Ave., Chicago, Ill.
Tagliabue, C. J., Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. O., Co., Detroit, Mich.

RECORDERS—Liquid Level:
American Meter Co., 60 East 42nd St New York City
Bailey Meter Co., 1038 Ivanhoe Road, Cleveland, Ohio
Bristol Company, The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Crosby Steam Gage & Valve Co., 165 Broadway, New York City
Foxboro Co., Foxboro, Mass.
Kent, George, Ltd., Luton, Bedfordshire, England
Leeds & Northrup Co., 4901 Stenson Ave., Philadelphia, Pa.
Mason Neilan Regulator Co., Boston, Mass
Moore Products Co., Philadelphia, Pa.
Republic Flow Meters Co., Chicago, Ill.
Simplex Valve & Meter Co., 68th and Upland, Philadelphia, Pa.
Tagliabue, C. J., Mfg. Co., Brooklyn, N.Y
Taylor Instrument Companies, Rochester, N. Y.
Tokheim Co., Cedar Rapids, Iowa

RECORDERS—Pressure:
American Meter Co., 60 East 42nd St., New York City
Ashton Valve Co., Cambridge, Mass.
Bailey Meter Co., 1038 Ivanhoe Road, Cleveland, Ohio
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Crosby Steam Gage & Valve Co., 165 Broadway, New York City
Esterline Angus Co., Indianapolis, Ind

Specify Arcco-Anubis Gravity Recorders



Hundreds of these precision-built, trouble-free specific gravity recorders are in service in U. S. pipelines. They maintain laboratory accuracy without attention. Send for bulletins and prices of these and other Arcco-Anubis instruments.

Arcco-Anubis Liquid Gravitometer

AMERICAN RECORDING CHART CO.
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Arcco-Anubis Gas Gravitometer

Foxboro Co., Foxboro, Mass.
Greiner, Emil, Co., 55 Van Dam St., New York City
Hayes, A. M., Corp., Michigan City, Ind.
Kent, George, Ltd., Luton, Bedfordshire, England
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Marsh, J. P., Corp., 2073 Southport, Chicago, Ill.
Mason Neilan Regulator Co., Boston, Mass.
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Refinery Supply Co., Tulsa, Okla.
Republic Flow Meters Co., Chicago, Ill.
Tagliabue, C. J., Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. O., Co., Detroit, Mich.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

RECORDERS—Temperature:
Bailey Meter Co., 1038 Ivanhoe Road, Cleveland, Ohio
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Englehard, Charles, Inc., Newark, N. J.
Foxboro Co., Foxboro, Mass.
Greiner, Emil, Co., 55 Van Dam St., New York City
Kent, George, Ltd., Luton, Bedfordshire, England
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Marsh, Jas. P., Corp., 2073 Southport, Chicago, Ill.
Mason Neilan Regulator Co., Boston, Mass.
Powers Regulator Co., 2720 Greenview Ave., Chicago, Ill.
Refinery Supply Co., Tulsa, Okla.
Republic Flow Meters Co., Chicago, Ill.
Tagliabue, C. J., Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Companies, Rochester, N. Y.
Tokheim Co., Cedar Rapids, Iowa
Trerice, H. O., Co., Detroit, Mich.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

RECORDERS—Wet and Dry Bulb:
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Foxboro Co., Foxboro, Mass.
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Mason Neilan Regulator Co., Boston, Mass.
Powers Regulator Co., 2720 Greenview Ave., Chicago, Ill.
Tagliabue, C. J., Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. O., Co., Detroit, Mich.

RECTIFIERS—Corrosion Protection:
Electrical Facilities, Inc., 4224 Holden St., Oakland, Calif.
Goodall Electric Mfg. Co., Ogallala, Neb.
Nelson Electric Mfg. Co., Tulsa, Okla.

REDUCERS—Pipe:
Chase Brass & Copper Co., Waterbury, Conn.
Clow, James B., & Sons, 201 N. Talman, Chicago, Ill.
Midwest Piping & Supply Co., St. Louis, Mo.
Walworth Co., 60 E. 42nd St., New York City

REFLEX GAUGES—See GAUGES, Reflex:

REFINERY PROCESSES—See PROCESSES, Refinery:

REFRACTORIES—See Specific Products:

REFRACTORIES:
Atlas Lumnite Cement Co., The, 135 E. 42nd St., New York City.
General Refractories Co., Philadelphia, Pa.
Green, A. P., Fire Brick Co., Mexico, Mo.
Harbison-Walker Refractories Co., 1800 Farmers Bank Bldg., Pittsburgh, Pa.
Johns-Manville, 22 E. 40th St., New York City
Kellogg Co., The M. W., 225 Broadway, New York City
Laclede Christy Clay Products Co., St. Louis, Mo.
Mexico Refractories Co., Mexico, Mo.
Norton Co., Worcester, Mass.
Quigley Co., Inc., 56 W. 54th St., New York City
Ruberoid Co., 500 5th Ave., New York City

REFRACTORY CEMENT—See CEMENT, Refractory

REFRIGERATING MACHINERY:
Carrier Corp., Syracuse, N. Y.
Croll-Reynolds Engineering Co., 17 John St., New York City
Frick Co., Waynesboro, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City
King Refrigeration Co., Toledo, Ohio
Vogt, Henry, Machine Co., Louisville, Ky.
Worthington Pump & Machinery Corp., Harrison, N. J.
York Ice Machinery Corp., York, Pa.

REGULATORS—Air Operated:
Atlas Valve Co., 276 South St., Newark, N. J.
Bailey Meter Co., 1038 Ivanhoe Road, Cleveland, Ohio
Belfield, H., Co., Philadelphia, Pa.
Bristol Co., The, Waterbury, Conn.
Cash, A. W., Co., Decatur, Ill.
Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago, Ill.
Fischer & Porter Co., Hatboro, Pa.
Fisher Governor Co., Marshalltown, Iowa
Foster Engineering Co., Newark, N. J.
Foxboro Co., Foxboro, Mass.
Grove Regulator Co., Oakland, Calif.
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
Kent, George, Ltd., Luton, Bedfordshire, England
Kieley & Mueller, Inc., North Bergen, N. J.
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Leslie Co., Lyndhurst, N. J.
McAlear Manufacturing Co., 1901 S. Western Ave., Chicago, Ill.
Mason Neilan Regulator Co., Boston, Mass.
Mercoid Corp., 4201 Belmont, Chicago, Ill
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Penn Electric Switch Co., Goshen, Ind.
Powers Regulator Co., 2720 Greenview Ave., Chicago, Ill.
Reynolds Gas Regulator Co., Anderson, Ind.
Republic Flow Meters Co., Chicago, Ill.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Spence Engineering Co., Inc., Walden, N. Y.
Tagliabue, C. J., Mfg. Co., Brooklyn, N.Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. O., Co., Detroit, Mich.
Webster Engineering Co., Tulsa, Okla.

REGULATORS—Air Pressure—See REGULATORS, Pressure:

REGULATORS—Back Pressure:
Acme Regulator Co., Tulsa, Okla.
American Meter Co., 60 East 42nd St., New York City
Atlas Valve Co., 276 South St., Newark, N. J.
Belfield, H., Co., Philadelphia, Pa.
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Bristol Co., The, Waterbury, Conn.
Cash, A. W., Co., Decatur, Ill.
Chaplin-Fulton Mfg. Co., 28-40 Penn Ave., Pittsburgh, Pa.
Connelly Iron Sponge & Governor Co., 3145 S. California, Chicago, Ill.
Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago, Ill.
Fisher Governor Co., Marshalltown, Iowa
Foster Engineering Co., Newark, N. J.
Foxboro Co., Foxboro, Mass.
Grove Regulator Co., Oakland, Calif.
Hanlon-Waters, Inc., Tulsa, Okla.
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
Kieley & Mueller, Inc., North Bergen N. J.
McAlear Manufacturing Co., 1901 S. Western, Chicago, Ill.
Mason Neilan Regulator Co., Boston, Mass.
Natural Gas Equipment, Inc., 714 W. Olympic Blvd., Los Angeles, Calif.
Penn Electric Switch Co., Goshen, Ind.
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Reading, Pa.
Republic Flow Meters Co., Chicago, Ill
Reynolds Gas Regulator Co., Anderson, Ind.
Ruggles Klingemann Mfg., Salem, Mass.
R-S Products Corp., 110 Berkeley St., Philadelphia, Pa.
Spence Engineering Co., Inc., Walden, N. Y.
Tagliabue, C. J., Mfg. Co., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. O., Co., Detroit, Mich.
Vapor Recovery Systems Co., The, Compton, Calif.
Webster Engineering Co., Tulsa, Okla.

REGULATORS—Boiler Fuel:
Atlas Valve Co., 276 South St., Newark, N. J.
Bailey Meter Co., 1038 Ivanhoe Road, Cleveland Ohio
Cash, A. W., Co., Decatur, Ill.
Chaplin-Fulton Mfg. Co., 28-40 Penn Ave., Pittsburgh, Pa.
Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago, Ill.
Engineer Co., 75 West St., New York City
Faber Engineering Co., Westmoreland and Amber Sts., Philadelphia, Pa.
Fisher Governor Co., Marshalltown, Iowa
Foxboro Co., Foxboro, Mass.
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Hanlon-Waters, Inc., Tulsa, Okla.
Hays, A. M., Corp., Michigan City, Ind.
Inferno Co., Shreveport, La.
Kieley & Mueller, Inc., North Bergen, N. J.
McAlear Manufacturing Co., 1901 S. Western, Chicago, Ill.
McDonnell & Miller, Wrigley Bldg., Chicago, Ill.
Mason Neilan Regulator Co., Boston, Mass.
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Mueller Co., Decatur, Ill.
National Airoil Burner Co., 1238 E. Sedgley Ave., Philadelphia, Pa.
Natural Gas Equipment, Inc., 714 W. Olympic Blvd., Los Angeles, Calif.
Penn Electric Switch Co., Goshen, Ind.
Red Devil Burner Co., Houston, Tex.
Republic Flow Meters Co., Chicago, Ill.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Taylor Instrument Companies, Rochester, N. Y.
Webster Engineering Co., Tulsa, Okla.

REGULATORS—Damper:
Atlas Valve Co., 276 South St., Newark, N. J.
Bailey Meter Co., 1038 Ivanhoe Road, Cleveland, Ohio.
Bristol Co., The, Waterbury, Conn.
Cash, A. W., Co., Decatur, Ill.
Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago, Ill.
Engineer Co., 75 West St., New York City
Faber Engineering Co., Westmoreland and Amber Sts., Philadelphia, Pa.
Foster Engineering Co., Newark, N. J.
Hagan, Corp., Hagan Bldg., Pittsburgh, Pa.
Hanlon-Waters, Inc., Tulsa, Okla.
Hays, A. M., Corp., Michigan City, Ind.

Kieley & Mueller, Inc., North Bergen, N. J.
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
Mason Neilan Regulator Co., Boston, Mass.
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Mueller Co., Decatur, Ill.
National Airoil Burner Co., 1238 E. Sedgley Ave., Philadelphia, Pa.
Natural Gas Equipment, Inc., 714 W. Olympic Blvd., Los Angeles, Calif.
Penn Electric Switch Co., Goshen, Ind.
Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Reading Pa.
Republic Flow Meters Co., Chicago, Ill.
Ruggles Klingemann Mfg. Co., Salem, Mass.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Sarco Co., Inc., 475 Fifth Ave., New York City
Tagliabue, C. J., Mfg. Co., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Webster Engineering Co., Tulsa, Okla.

REGULATORS—Feed Water:
Atlas Valve Co., 276 South St., Newark, N. J.
Bailey Meter Co., 1038 Ivanhoe Road, Cleveland, Ohio.
Belfield, H., Co., Philadelphia, Pa.
Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence, R. I.
Chaplin-Fulton Mfg. Co., 28-40 Penn Ave., Pittsburgh, Pa.,
Fisher Governor Co., Marshalltown, Iowa
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Hanlon-Waters, Inc., Tulsa, Okla.
Inferno Co., Shreveport, La.,
McAlear Manufacturing Co., 1901 S. Western, Chicago, Ill.
McDonnell & Miller, Wrigley Bldg., Chicago, Ill.
Mason Neilan Regulator Co., Boston, Mass.
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Mueller Co., Decatur, Ill.
Natural Gas Equipment, Inc., 714 W. Olympic Blvd., Los Angeles, Calif.
Northern Equipment Co., Erie, Pa.
Penn Electric Switch Co., Goshen, Ind.
Republic Flow Meters Co., Chicago, Ill.
Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Reading Pa.
Reynolds Gas Regulator Co., Anderson, Ind.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Swartwout Co., The, 18511 Euclid Ave., Cleveland, Ohio
Tagliabue, C. J., Mfg. Co., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Webster Engineering Co., Tulsa, Okla.
Wright-Austin Co., 315 W. Woodbridge Detroit, Mish.

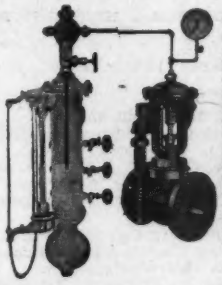
REGULATORS — Gas and Air Pressure — See REGULATORS, Pressure:

REGULATORS—Liquid Level — See CONTROLLERS, Liquid Level:

REGULATORS—Liquid Petroleum Gas:
Acme Regulator Co., Tulsa, Okla.
Cash, A. W., Co., Decatur, Ill.
Fisher Governor Co., Marshalltown, Iowa
Foster Engineering Co., Newark, N. J.
Grove Regulator Co., Oakland, Calif.
Hanlon-Waters, Inc., Tulsa, Okla.
Inferno Co., Shreveport, La.
Kieley & Mueller, Inc., North Bergen, N. J.
McAlear Manufacturing Co., 1901 S. Western, Chicago, Ill.
Mason Neilan Regulator Co., Boston, Mass.
Penn Electric Switch Co., Goshen, Ind.
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Reynolds Gas Regulator Co., Anderson, Ind.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Tagliabue, C. J., Mfg. Co., Brooklyn, N. Y.

REGULATORS—Oxygen and Acetylene Pressure:
Air Reduction Sales Co., 60 E. 42nd St., New York City
Alexander Milburn Co., Baltimore, Md.
Grove Regulator Co., Oakland, Calif.
Linde Air Products Co., The, 30 E. 42nd St., New York City
Modern Engineering Co., St. Louis, Mo.
National Cylinder Gas Co., 205 W. Wacker, Chicago, Ill.
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Spence Engineering Co., Inc., Walden, N. Y.

REGULATORS—Pressure:
Acme Regulator Co., Tulsa, Okla.
American Meter Co., 60 E. 42nd St., New York City
Alexander Milburn Co., Baltimore, Md.
Atlas Valve Co., 276 South St., Newark, N. J.



This is the CAMPBELL Boiler Feed Water Regulator which contains no moving parts; no thermostats; no floats, no generators. The Regulator and Sampling Pipe are shown at the left, and the ATLAS Control Valve easily piped to the Regulator, is at the right.

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Bristol Co., The, Waterbury, Conn.
Cash, A. W., Co., Decatur, Ill.
Chaplin-Fulton Mfg. Co., 28-40 Penn Ave., Pittsburgh, Pa.
Clark Controller Co., 1146 E. 152nd St., Cleveland, Ohio
Connelly Iron Sponge & Governor Co., 3154 S. California, Chicago, Ill.
Cutler Hammer, Inc., Milwaukee, Wis.
Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago, Ill.
Enardo Foundry & Mfg. Co., Tulsa, Okla.
Engineer Co., 75 West St., New York City
Fisher Governor Co., Marshalltown, Iowa
Foster Engineering Co., Newark, N. J.
Foxboro Co., Foxboro, Mass.
Fulton Sylphon Co., The, Knoxville, Tenn.
Grove Regulator Co., Oakland, Calif.
Hanlon-Waters, Inc., Tulsa, Okla.
Hays, A. M., Corp., Michigan City, Ind.
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
Kent, George, Ltd., Luton, Bedfordshire, England
Kieley & Mueller, Inc., North Bergen, N. J.
Leslie Co., Lyndhurst, N. J.
McAlear Manufacturing Co., 1901 S. Western, Chicago, Ill.
McDonnell & Miller, Wrigley Bldg., Chicago, Ill.
Mason Neilan Regulator Co., Boston, Mass.
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Moore Products Co., Philadelphia, Pa.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Modern Engineering Co., St. Louis, Mo.
Mueller Co., Decatur, Ill.
Natural Gas Equipment, Inc., 714 W. Olympic Blvd., Los Angeles, Calif.
Northern Equipment Co., Erie, Pa.
Oil Well Supply Co., Dallas, Tex.
Penn Electric Switch Co., Goshen, Ind.
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Powers Regulator Co., 2720 Greenview Ave., Chicago, Ill.
Republic Flow Meters Co., Chicago, Ill.
Reynolds Gas Regulator Co., Anderson, Ind.
Ruggles Klingemann Mfg. Co., Salem, Mass.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Spence Engineering Co., Inc., Walden, N. Y.
Squires, C. E., Co., 3934 Kelly Ave., Cleveland, Ohio
Strong, Carlisle & Hammond Co., The, 1392 W. 3rd St., Cleveland, Ohio
Swartwout Co., The, 18511 Euclid Ave., Cleveland, Ohio
Tagliabue, C. J., Mfg. Co., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. O., Co., Detroit, Mich.
Vapor Recovery Systems Co., The, Compton, Calif.
Webster Engineering Co., Tulsa, Okla.
Wheelco Instruments Co., Harrison and Peoria Sts., Chicago, Ill.

REGULATORS—Pressure Reducing:
Acme Regulator Co., Tulsa, Okla.
Atlas Valve Co., 276 South St., Newark, N. J.
Bailey Meter Co., 1038 Ivanhoe Road, Cleveland, Ohio
Belfield, H., Co., Philadelphia, Pa.
Cash, A. W., Co., Decatur, Ill.
Chaplin-Fulton Mfg. Co., 28-40 Penn Ave., Pittsburgh, Pa.
Connelly Iron Sponge & Governor Co., 3154 S. California, Chicago, Ill.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago, Ill.
Fisher Governor Co., Marshalltown, Iowa
Foster Engineering Co., Newark, N. J.
Fulton Sylphon Co., The, Knoxville, Tenn.
Grove Regulator Co., Oakland, Calif.
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Hanlon-Waters, Inc., Tulsa, Okla.
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
Kieley & Mueller, Inc., North Bergen, N. J.
Leslie Co., Lyndhurst, N. J.
McAlear Manufacturing Co., 1901 S. Western, Chicago, Ill.
Mason-Neilan Regulator Co., Boston, Mass.
Modern Engineering Co., St. Louis, Mo.
Mueller Co., Decatur, Ill.
Natural Gas Equipment, Inc., 714 W. Olympic Blvd., Los Angeles, Calif.
Northern Equipment Co., Erie, Pa.
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Powers Regulator Co., 2720 Greenview Ave., Chicago, Ill.
Republic Flow Meters Co., Chicago, Ill.
Reynolds Gas Regulator Co., Anderson, Ind.
Ruggles Klingemann Mfg. Co., Salem, Mass.
Spence Engineering Co., Inc., Walden, N. Y.
Squires, C. E., Co., 3934 Kelly Ave., Cleveland, Ohio

Strong, Carlisle & Hammond Co., The, 1392 W. 3rd St., Cleveland, Ohio
Swartwout Co., The, The 18511 Euclid Ave., Cleveland, Ohio
Tagliabue, C. J., Mfg. Co., Brooklyn, N. Y.
Trerice, H. O., Co., Detroit, Mich.
Vapor Recovery Systems Co., The, Compton, Calif.
Webster Engineering Co., Tulsa, Okla.

REGULATORS—Pump—See GOVERNORS, Pump:

REGULATORS — Steam Pressure — See REGULATORS, Pressure:

REGULATORS — Temperature — See CONTROLLERS, Temperature:

REGULATORS—Vacuum:
Bristol Co., The, Waterbury, Conn.
Cash, A. W., Co., Decatur, Ill.
Chaplin-Fulton Mfg. Co., 28-40 Penn Ave., Pittsburgh, Pa.
Cutler Hammer, Inc., Milwaukee, Wis.
Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago, Ill.
Fisher Governor Co., Marshalltown, Iowa
Foster Engineering Co., Newark, N. J.
Foxboro Co., Foxboro, Mass.
Greiner, Emil, Co., 55 Van Dam St., New York City
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Hanlon-Waters, Inc., Tulsa, Okla.
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
Kieley & Mueller, Inc., North Bergen, N. J.
Mason-Neilan Regulator Co., Boston, Mass.
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Natural Gas Equipment, Inc., 714 W. Olympic Blvd., Los Angeles, Calif.
Penn Electric Switch Co., Goshen, Ind.
Pittsburgh Equitable Meter Co., Homewood, Pittsburgh, Pa.
Powers Regulator Co., 2720 Greenview Ave., Chicago, Ill.
Republic Flow Meters Co., Chicago, Ill.
Reynolds Gas Regulator Co., Anderson, Ind.
Shand & Jurs Co., Berkeley, Calif.
Trerice, H. O., Co., Detroit, Mich.
Vapor Recovery Systems Co., The, Compton, Calif.

REGULATORS—Vapor Recovery:
Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago, Ill.
Foxboro Co., Foxboro, Mass.
Hanlon-Waters, Inc., Tulsa, Okla.
McAlear Manufacturing Co., 1901 S. Western, Chicago, Ill.
Mason-Neilan Regulator Co., Boston, Mass.
Natural Gas Equipment, Inc., 714 W. Olympic Blvd., Los Angeles, Calif.
Shand & Jurs Co., Berkeley, Calif.
Vapor Recovery Systems Co., The, Compton, Calif.

REGULATORS—Voltage:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Clark Controller Co., 1146 E. 152nd St., Cleveland, Ohio
Electric Machinery Mfg. Co., Minneapolis, Minn.
General Electric Co., Schenectady, N. Y.
Simplex Corp., East Moline, Ill.

RELAYS—Electric:
American Automatic Electric Sales Co., 1033 W. Van Buren, Chicago, Ill.
Automatic Switch Co., 41 E. 11th St., New York City
Bradley, Allen, Milwaukee, Wis.
Clark Controller Co., 1146 E. 152nd St., Cleveland, Ohio
Cutler Hammer, Inc., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Greiner, Emil, Co., 55 Van Dam St., New York City
Guardian Electric Co., 1623 W. Walnut St., Chicago, Ill.
Mercoid Corp., 4201 Belmont, Chicago, Ill.
Nelson Electric Mfg. Co., Tulsa, Okla.
Penn Electric Switch Co., Goshen, Ind.
Square D Co., Milwaukee, Wis.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Weston Electrical Instrument Corp., Newark, N. J.

RESPIRATORS:
American Optical Co., Southbridge, Mass.
Boyer-Campbell Co., 6540 St. Antoine St., Detroit, Mich.
Goggle Parts Co., The, Century Bldg., Cleveland, Ohio
Goodrich, B. F., Co., Akron, Ohio
Industrial Products Co., 2828 N. 4th St., Philadelphia, Pa.
Mine Safety Appliances Co., Pittsburgh, Pa.
Sellstrom Mfg. Co., 615 N. Aberdeen, Chicago, Ill.

RETORTS:
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Bethlehem Foundry & Machine Co., Bethlehem, Pa.
Lancaster Iron Works, Lancaster, Pa.
Ohio Steel Foundry Co., The, Springfield, Ohio

RETURN BENDS—See BENDS, Return:

RETURN BENDS—Welding: See FITTINGS, Welding:

RETURN HEADERS—See HEADERS, Return:

ROCK WOOL — See INSULATION, Rock Wool:

RODS—Brass or Bronze, all Shapes:
American Brass Co., 25 Broadway, New York City
Champion Rivet Co., The, E. 108th St. and Harvard Ave., Cleveland, Ohio
Chase Brass & Copper Co., Waterbury, Conn.
Gilbert Brass Foundry Co., St. Louis, Mo.
Saginaw Bearing Co., Saginaw, Mich.
Scovill Mfg. Co., Waterbury, Conn.

RODS — Welding: See WELDING ELECTRODES and RODS:

ROOFING MATERIALS:
Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
American-Marietta Co., 43 E. Ohio, Chicago, Ill.
Asbestos & Engineering Products, Ltd., London, England
Carey, Philip, Mfg. Co., The, Cincinnati, Ohio
Carnegie-Illinois Steel Corp., 434 Fifth Ave., Pittsburgh, Pa.
Chase Brass & Copper Co., Waterbury, Conn.
Johns-Manville Corp., 22 E. 40th St., New York City
Keasbey & Mattison Co., Ambler, Pa.
Koppers Co., Koppers Bldg., Pittsburgh, Pa.
Lucas, Robert M., Co., 1955 West 31st St., Chicago, Ill.
Maintenance, Inc., Wooster, Ohio
Myers, A. M., Co., Box 83, Pittsburgh, Pa.
Reilly Tar & Chemical Co., Indianapolis, Ind.
Ruberoid Co., 500 Fifth Ave., New York City
Sullivan Co., The, Memphis, Tenn.
Tnemec Co., Inc., Kansas City, Mo.
Truscon Steel Co., Youngstown, Ohio

ROOFING—Corrugated Asbestos:
Asbestos & Engineering Products, Ltd., London, England
Carey, Philip, Mfg. Co., The, Cincinnati, Ohio
Johns-Manville Corp., 22 E. 40th St., New York City
Keasbey & Mattison Co., Ambler, Pa.
Ruberoid Co., 500 Fifth Ave., New York City

ROOFS—Tank, Breather:
Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
Chicago Bridge & Iron Co., 332 S. Michigan, Chicago, Ill.

ROOFS—Tank, Floating:
Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
Chicago Bridge & Iron Co., 332 S. Michigan, Chicago, Ill.

ROOFS—Furnace:
Bigelow-Liptak Corp., 2842 W. Grand Blvd., Detroit, Mich.
Furnace Economy Co., 201 N. Wells St., Chicago, Ill.
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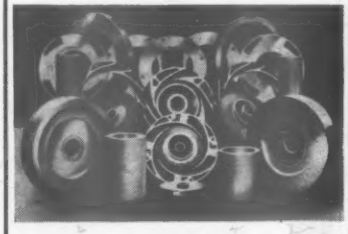

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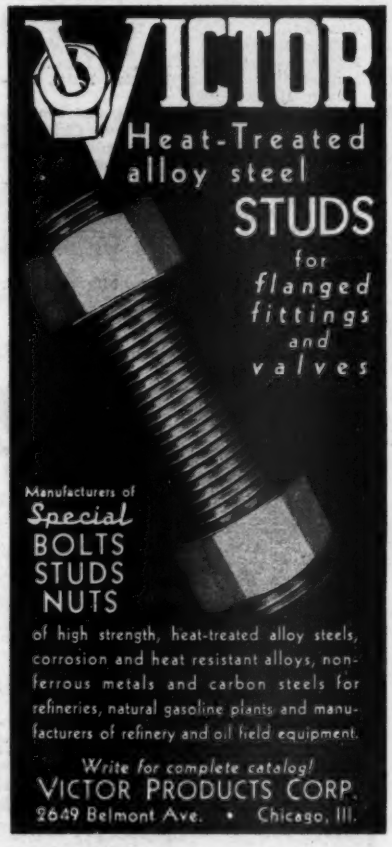
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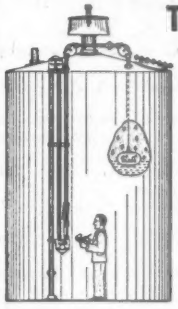

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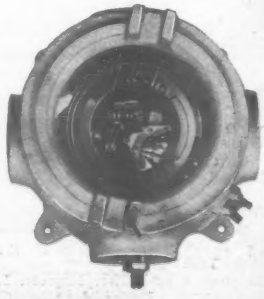

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Morrison Brothers, Dubuque, Iowa
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National Radiator Co., The, Johnstown, Pa.
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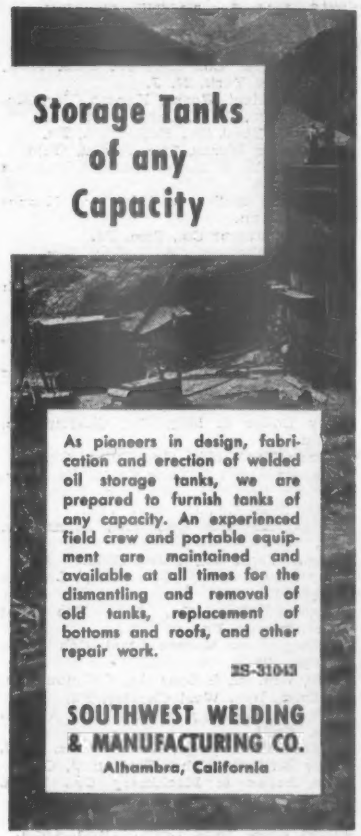
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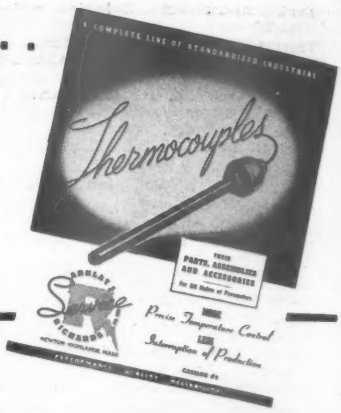

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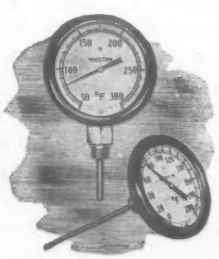

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Beaver Pipe Tools, Inc., Warren, Ohio
Bignall & Keeler Machine Works, Edwardsville, Ill.
Dearborn Chemical Co., 310 S. Michigan, Chicago, Ill.
Jarecki Mfg. Co., St. Louis, Mo.
Landis Machine Co., Waynesboro, Pa.
National Machine Works, 1559 N. Sheffield, Chicago, Ill.
Nye Tool & Machine Co., Chicago, Ill.
Oster Mfg. Co., The, Cleveland, Ohio
Toledo Pipe Threading Machine Co., Toledo, Ohio

TILE—Baffle:
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Engineer Co., 75 West St., New York City
Furnace Economy Co., 201 N. Wells St., Chicago, Ill.
General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburg, Pa.
Kellogg Co., The M. W., 225 Broadway, New York City
Laclede Christy Clay Products Co., St. Louis, Mo.
McLeod & Henry Co., Troy, N. Y.
Mexico Refractories Co., Mexico, Mo.
North American Refractory Co., Cleveland, Ohio
U. S. Stoneware Co., Akron, Ohio

TILE—Cork:
Armstrong Cork Products Co., Lancaster, Pa.

TILE—Refractory:
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Botfield Refractories Co., 776 S. Swanson St., Philadelphia, Pa.
Carborundum Co., Niagara Falls, N. Y.
Engineer Co., 75 West St., New York City
Furnace Economy Co., 201 N. Wells St., Chicago, Ill.
General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburg, Pa.
Kellogg Co., The M. W., 225 Broadway, New York City
Laclede Christy Clay Products Co., St. Louis, Mo.
North American Refractory Co., Cleveland, Ohio
Norton Co., Worcester, Mass.
Stein, John G., & Co., Ltd., Bonnybridge, Scotland
U. S. Stoneware Co., Akron, Ohio

TOOL HOUSES—See HOUSES, Tool

TOOLS, Hand—See Specific Tools

TOOLS—Nonsparking, Safety:
Ampco Metals, Inc., Milwaukee, Wis.
Beryllium Corp. of Pa., Reading, Pa.
Davis Emergency Equipment Co., Inc., Newark, N. J.
Industrial Products Co., 2828 N. 4th St., Philadelphia, Pa.

TOOLS, Pneumatic—See Specific Tools

TOWER PACKING (Rings, Blocks, Etc.):
Carborundum Co., Niagara Falls, N. Y.
Continental-Diamond Fibre Co., Bridgeport, Pa.
Corning Glass Works, Corning, N. Y.
Crane Packing Co., 1801 Belleplaine Ave., Chicago, Ill.
General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa.
Haveg Corp., Newark, Del.
Kellogg Co., The M. W., 225 Broadway, New York City
Knight, Maurice A., Akron, Ohio
National Carbon Co., Inc., Cleveland, Ohio
U. S. Stoneware Co., Akron, Ohio

TOWERS—Bubble:
Aluminum Co. of America, 801 Gulf Bldg., Pittsburg, Pa.
American Locomotive Co., Alco Products Div., 30 Church St., New York City
Babcock & Wilcox Co., The, 85 Liberty St., New York City
Badger, E. B., & Sons Co., Boston, Mass.
Beaird Corp., J. B., Shreveport, La.
Biggs Boiler Works, The, Akron, Ohio
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Blaw-Knox Co., Blawnox, Pa.
Braun, C. F., & Co., Inc., Alhambra, Calif.
Butane Equipment Co., Inc., Dallas, Tex.
Combustion Engineering Co., Inc., 201 Madison Ave., New York City
Devine, J. P., Manufacturing Co., Mount Vernon, Ill.

Edge Moore Iron Works, Inc., 30 Rockefeller Plaza, New York City
Foster Wheeler Corp., 165 Broadway, New York City
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Graver Tank & Mfg. Co., 4809 Todd, East Chicago, Ind.
Haveg Corp., Newark, Del.
Hudson Engineering Co., Houston, Tex.
Kellogg Co., The M. W., 225 Broadway, New York City
Lancaster Iron Works, Lancaster, Pa.
McNamar Boiler & Tank Co., Tulsa, Okla.
Muskegon Boiler Works, Muskegon, Mich.
National Tank Co., Tulsa, Okla.
Oxley Engineering Co., Ltd., London, England
Patterson-Kelley Co., Inc., The, E. Stroudsburg, Pa.
Smith, A. O., Corp., Milwaukee, Wis.
Southwest Welding & Mfg. Co., Alhambra, Calif.
Southwestern Engineering Co., Los Angeles, Cal.
Standard Steel Corp., Los Angeles, Calif.
Stacey Mfg. Co., The, Cincinnati, Ohio
Stearns-Roger Mfg. Co., Denver, Colo.
Struthers-Wells, Warren, Pa.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Voigt, Henry, Machine Co., Louisville, Ky.
Vulcan Steel Tank Corp., Tulsa, Okla.
Wheland Co., Chattanooga, Tenn.
Wyatt Metal & Boiler Works, Houston, Tex.

TOWERS, Cooling — See COOLING TOWERS

TOWERS—Evaporator:
American Locomotive Co., Alco Products Div., 30 Church St., New York City
Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees, England
Badger, E. B., & Sons Co., Boston, Mass.
Beaird Corp., J. B., Shreveport, La.
Biggs Boiler Works, The, Akron, Ohio
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Butane Equipment Co., Inc., Dallas, Tex.
Chicago Bridge & Iron Co., 332 S. Michigan Ave., Chicago, Ill.
Devine, J. P., Manufacturing Co., Mount Vernon, Ill.
Foster Wheeler Corp., 165 Broadway, New York City
Gasoline Plant Construction Co., Houston, Tex.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Haveg Corp., Newark, Del.
Hudson Engineering Co., Houston, Tex.
Kellogg Co., The M. W., 225 Broadway, New York City
Lancaster Iron Works, Lancaster, Pa.
Muskegon Boiler Works, Muskegon, Mich.
National Tank Co., Tulsa, Okla.
Oxley Engineering Co., Ltd., London, England
Southwest Welding & Mfg. Co., Alhambra, Calif.
Standard Steel Corp., Los Angeles, Calif.
Stearns-Roger Mfg. Co., Denver, Colo.
Sun Shipbuilding & Dry Dock Co., Chester, Pa.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Vulcan Steel Tank Corp., Tulsa, Okla.
Wyatt Metal & Boiler Works, Houston, Tex.

TOWERS—Fractionating:
Aluminum Co. of America, 801 Gulf Bldg., Pittsburg, Pa.
American Locomotive Co., Alco Products Div., 30 Church St., New York City
Badger, E. B., & Sons Co., Boston, Mass.
Beaird Corp., J. B., Shreveport, La.
Biggs Boiler Works, The, Akron, Ohio
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Blaw-Knox Co., Blawnox, Pa.
Braun, C. F., & Co., Inc., Alhambra, Calif.
Butane Equipment Co., Inc., Dallas, Tex.
Chicago Bridge & Iron Co., 332 S. Michigan Ave., Chicago, Ill.
Devine, J. P., Manufacturing Co., Mount Vernon, Ill.
Edge Moore Iron Works, Inc., 30 Rockefeller Plaza, New York City
Foster Wheeler Corp., 165 Broadway, New York City
Gasoline Plant Construction Co., Houston, Tex.
General American Transportation Corp., 135 S. La Salle St., Chicago, Ill.
Graver Tank & Mfg. Co., 4809 Todd, East Chicago, Ind.
Haveg Corp., Newark, Del.
Hudson Engineering Co., Houston, Tex.
Kellogg Co., The M. W., 225 Broadway, New York City
Lancaster Iron Works, Lancaster, Pa.
McNamar Boiler & Tank Co., Tulsa, Okla.
Muskegon Boiler Works, Muskegon, Mich.
National Carbon Co., Inc., Cleveland, Ohio
National Tank Co., Tulsa, Okla.
Oxley Engineering Co., Ltd., London, England
Patterson-Kelley Co., Inc., The, E. Stroudsburg, Pa.
Smith, A. O., Corp., Milwaukee, Wis.
Southwest Welding & Mfg. Co., Alhambra, Calif.

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Sun Shipbuilding & Dry Dock Co., Chester, Pa.
Stacey Mfg. Co., The, Cincinnati, Ohio
Standard Steel Corp., Los Angeles, Calif.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Vulcan Steel Tank Corp., Tulsa, Okla.
Watkins, Inc., Wichita, Kan.
Wyatt Metal & Boiler Works, Houston, Tex.

TRANSPORTATION—Liquefied Petroleum:
McNamar Boiler & Tank Co., Tulsa, Okla.
Southwest Welding & Mfg. Co., Alhambra, Calif.

TRANSFORMERS—Distribution:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Kuhlman Electric Co., Bay City, Mich.
Moloney Electric Co., St. Louis, Mo.
Wagner Electric Corp., St. Louis, Mo.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

TRANSFORMERS—Power:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Kuhlman Electric Co., Bay City, Mich.
Moloney Electric Co., St. Louis, Mo.
Wagner Electric Corp., St. Louis, Mo.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

TRAPS—Air:
Anderson, V. D., Co., Cleveland, Ohio
Mich.
Armstrong Machine Works, Three Rivers,
Fisher Governor Co., Marshalltown, Iowa
Hanlon-Waters, Inc., Tulsa, Okla.
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
Kaye & MacDonald, Inc., West Orange, N. J.
Kieley & Mueller, Inc., North Bergen, New Jersey
McAlear Manufacturing Co., 1901 S. Western, Chicago, Ill.
McNamar Boiler & Tank Co., Tulsa, Okla.
Nicholson, W. H., & Co., Wilkes-Barre, Pa.
Sarco Co., Inc., 475 5th Ave., New York City
Squires, C. E., Co., 3934 Kelly Ave., Cleveland, Ohio
Strong, Carlisle & Hammond Co., The, 1392 W. 3rd St., Cleveland, Ohio
Trerice, H. O., Co., Detroit, Mich.
Wright-Austin Co., 315 W. Woodbridge, Detroit, Mich.

TRAPS—Ball Float:
Anderson, V. D., Co., Cleveland, Ohio
Armstrong Machine Works, Three Rivers, Mich.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Fisher Governor Co., Marshalltown, Iowa
Hanlon-Waters, Inc., Tulsa, Okla.
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
Kaye & McDonald, Inc., West Orange, N. J.
Kieley & Mueller, Inc., North Bergen, New Jersey
McAlear Manufacturing Co., 1901 S. Western, Chicago, Ill.
Milwaukee Valve Co., Milwaukee, Wis.
Newman, Hender & Co., Ltd., Woodchester, England
Nicholson, W. H., & Co., Wilkes-Barre, Pa.
Sarco Co., Inc., 475 5th Ave., New York City
Strong, Carlisle & Hammond Co., The, 1392 W. 3rd St., Cleveland, Ohio
Wright-Austin Co., 315 W. Woodbridge, Detroit, Mich.

TRAPS—Blast:
Anderson, V. D., Co., Cleveland, Ohio
Armstrong Machine Works, Three Rivers, Mich.
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
Kaye & McDonald, Inc., West Orange, N. J.
McAlear Manufacturing Co., 1901 S. Western, Chicago, Ill.
Milwaukee Valve Co., Milwaukee, Wis.
Nicholson, W. H., & Co., Wilkes-Barre, Pa.
Sarco Co., Inc., 475 5th Ave., New York City
Strong, Carlisle & Hammond Co., The, 1392 W. 3rd St., Cleveland, Ohio
Trerice, H. O., Co., Detroit, Mich.
Wright-Austin Co., 315 W. Woodbridge, Detroit, Mich.

TRAPS—Bucket:
Anderson, V. D., Co., Cleveland, Ohio
Armstrong Machine Works, Three Rivers, Mich.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Crane Co., Michigan Ave., Chicago, Ill.
Fisher Governor Co., Marshalltown, Iowa
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
Kaye & McDonald, Inc., West Orange, N. J.
Kieley & Mueller, Inc., North Bergen, New Jersey
Newman, Hender & Co., Ltd., Woodchester, England
Sarco Co., Inc., 475 5th Ave., New York City
Strong, Carlisle & Hammond Co., The, 1392 W. 3rd St., Cleveland, Ohio
Swartwout Co., The, 18511 Euclid Ave., Cleveland, Ohio
Trerice, H. O., Co., Detroit, Mich.
Vapor Recovery Systems Co., Compton, Calif.
Wright-Austin Co., 315 W. Woodbridge, Detroit, Mich.

TRAPS, Gasoline:
Anderson, V. D., Co., Cleveland, Ohio
Armstrong Machine Works, Three Rivers, Mich.
Fisher Governor Co., Marshalltown, Iowa
Hanlon-Waters, Inc., Tulsa, Okla.
McAlear Manufacturing Co., 1901 S. Western, Chicago, Ill.
McNamar Boiler & Tank Co., Tulsa, Okla.
Nicholson, W. H., & Co., Wilkes-Barre, Pa.
Strong, Carlisle & Hammond Co., The, 1392 W. 3rd St., Cleveland, Ohio
Swartwout Co., The, 18511 Euclid Ave., Cleveland, Ohio
Wright-Austin Co., 315 W. Woodbridge, Detroit, Mich.

TRAPS—Steam:
American District Steam Co., N. Tonawanda, N. Y.
Anderson, V. D., Co., Cleveland, Ohio
Armstrong Machine Works, Three Rivers, Mich.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Fisher Governor Co., Marshalltown, Iowa
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
Hanlon-Waters, Inc., Tulsa, Okla.
Kaye & McDonald, Inc., West Orange, N. J.
Kieley & Mueller, Inc., North Bergen, New Jersey
McAlear Manufacturing Co., 1901 S. Western, Chicago, Ill.
Milwaukee Valve Co., Milwaukee, Wis.
Newman, Hender & Co., Ltd., Woodchester, England
Nicholson, W. H., & Co., Wilkes-Barre, Pa.
Powers Regulator Co., 2720 Greenview Ave., Chicago, Ill.
Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Reading, Pa.
Sarco Co., Inc., 475 5th Ave., New York City

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Three types of steam traps are necessary for successful refinery operation. Sarco Bucket Trap for supply lines to pumps, turbines, general use. Equipped with integral strainers, straight thru connections. Pressures up to 900 lbs. Cat. 350. Sarco Thermostatic Traps Nos. 9 and 87 for heater lines, general outdoor use. Conserves steam, can't freeze, no seat changes. Cat. 250. Sarco Float-thermostatic Traps with automatic air vents for close temperature control. Cat. 450.
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Squires, C. E., Co., 3934 Kelly Ave., Cleveland, Ohio
Stewarts & Lloyds, Ltd., Glasgow, Scotland
Strong, Carlisle & Hammond Co., The, 1392 W. 3rd St., Cleveland, Ohio
Swartwout Co., The, 18511 Euclid Ave., Cleveland, Ohio
Tagliabue, C. J., Mfg. Co., Brooklyn, N. Y.
Trerice Co., H. O., Detroit, Mich.
Wright-Austin Co., 315 W. Woodbridge, Detroit, Mich.
Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.

TRAPS—Vacuum:
Anderson, V. D., Co., Cleveland, Ohio
Fisher Governor Co., Marshalltown, Iowa
Hanlon-Waters, Inc., Tulsa, Okla.
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
McAlear Manufacturing Co., 1901 S. Western, Chicago, Ill.
Strong, Carlisle & Hammond Co., The, 1392 W. 3rd St., Cleveland, Ohio
Swartwout Co., The, 18511 Euclid Ave., Cleveland, Ohio
Trerice, H. O., Co., Detroit, Mich.
Wright-Austin Co., 315 W. Woodbridge, Detroit, Mich.

TRAYS—Bubble:
Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
Badger, E. B., & Sons Co., Boston, Mass.
Beaird Corp., J. B., Shreveport, La.
Biggs Boiler Works, The, Akron, Ohio
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Braun, C. F., & Co., Inc., Alhambra, Calif.
Continental-Diamond Fibre Co., Bridgeport, Pa.
Devine, J. P., Manufacturing Co., Mount Vernon, Ill.
Fluor Corp., Ltd., Box 7030, Los Angeles, Calif.
Hadfields, Ltd., London, England
Hudson Engineering Co., Houston, Tex.
Kellogg Co., The M. W., 225 Broadway, New York City
Kinney Iron Works, Los Angeles, Calif.
Lancaster Iron Works, Lancaster, Pa.
McKee, Arthur G., & Co., Cleveland, Ohio
Mosher Steel Co., Houston, Tex.
Ohio Steel Foundry Co., The, Springfield, Ohio
Southwestern Engineering Co., Los Angeles, Calif.
Stearns-Roger Mfg. Co., Denver, Colo.
Tulsa Boiler & Machinery Co., Tulsa, Okla.
Vulcan Steel Tank Corp., Tulsa, Okla.
Watkins, Inc., Wichita, Kans.
Weber Engine Works, Kansas City, Mo.
Western Iron & Foundry Co., Wichita, Kansas
Wheland Co., Chattanooga, Tenn.
Winkler-Koch Engineering Co., Wichita, Kans.
Wyatt Metal & Boiler Works, Houston, Tex.

TREADS—Stair—See STAIR TREADS, Steel

TREATERS—Emulsions:
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla
Burt Tank, Separator & Oil Treating Corp., Wichita Falls, Tex.
National Tank Co., Tulsa, Okla.

TREATERS—Continuous:
Gray Processes Corp., 26 Journal Square, Jersey City, N. J.
%Proportioneers, Inc.%, Providence, R. I.
Sharples Corp., The, Philadelphia, Pa.
Turbo-Mixer Corp., The, 247 Park Ave., New York City
Winkler-Koch Engineering Co., Wichita, Kans.

TREATERS—De-salting—See PLANTS—De-salting:

TREATING PLANTS—See PLANTS

TUBE CLEANERS—See CLEANERS, Tube

TUBE EXPANDERS—See EXPANDERS, Tube

TUBE HANGERS—See SUPPORTS, Tube

TUBE SUPPORTS—See SUPPORTS, Tube:

TUBES—Alloy-Steel:
Babcock & Wilcox Tube Co., The, 85 Liberty St., New York City
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., The, Kenilworth, N. J.
Duraloy Co., The, Scottdale, Pa.
Globe Steel Tubes Co., Milwaukee, Wis.
Kellogg Co., The M. W., 225 Broadway, New York City
National Tube Co., Box 266, Pittsburgh, Pa.
Ohio Seamless Tube Co., The, Shelby, Ohio
Ohio Steel Foundry Co., The, Springfield, Ohio
Pittsburgh Piping & Equipment Co., 10-43rd St., Pittsburgh, Pa.
Pittsburgh Steel Co., Grant Bldg., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, Ohio
Revere Copper & Brass, Inc., 230 Park Ave., New York City
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Steel & Tubes Division, Republic Steel Corp., Cleveland, Ohio
Texas Pipe Bending Co., Houston, Tex.
Timken Roller Bearing Co. (Steel and Tube Div.), Canton, Ohio
Wolverine Tube Co., 1411 Central Ave., Detroit, Mich.
Youngstown Sheet & Tube Co., The, Youngstown, Ohio

TUBES—Boiler:
Allegheny Ludlum Steel Corp., Brackenridge, Pa.
Babcock & Wilcox Tube Co., The, 85 Liberty St., New York City
Bethlehem Steel Co., Bethlehem, Pa.
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Globe Steel Tubes Co., Milwaukee, Wis.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
National Tube Co., Box 266, Pittsburgh, Pa.
Ohio Seamless Tube Co., The, Shelby, Ohio
Pittsburgh Steel Co., Grant Bldg., Pittsburgh, Pa.
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Steel & Tubes Division, Republic Steel Corp., Cleveland, Ohio
Stewarts & Lloyds, Ltd., Glasgow, Scotland
Youngstown Sheet & Tube Co., The, Youngstown, Ohio

TUBES—Brass and Copper:
American Brass Co., 25 Broadway, New York City
Bridgeport Brass Co., Bridgeport, Conn.
Chase Brass & Copper Co., Waterbury, Conn.
Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Gilbert Brass Foundry Co., St. Louis, Mo.
Revere Copper & Brass, Inc., 230 Park Ave., New York City
Scovill Mfg. Co., Waterbury, Conn.
Wolverine Tube Div., 1411 Central Ave., Detroit, Mich.

TUBES—Condensers:
Allegheny Ludlum Steel Corp., Brackenridge, Pa.
American Brass Co., 25 Broadway, New York City
Babcock & Wilcox Tube Co., The, 85 Liberty St., New York City
Bridgeport Brass Co., Bridgeport, Conn.
Brown Fintube Co., The, Elyria, Ohio
Byers, A. M., Co., Box 83, Pittsburgh, Pa.
Carpenter Steel Co., Kenilworth, N. J.
Cast Iron Pipe Research Ass'n., 122 S. Michigan, Chicago, Ill.
Chase Brass & Copper Co., Waterbury, Conn.

Condenser Service & Engr. Co., Inc., Hoboken, N. J.
Engineers & Fabricators, Inc., Houston, Tex.
Globe Steel Tubes Co., Milwaukee, Wis.
Kellogg Co., The M. W., 225 Broadway, New York City
McWane Cast Iron Pipe Co., Birmingham, Ala.
National Tube Co., Box 266, Pittsburgh, Pa.
Ohio Seamless Tube Co., The, Shelby, Ohio
Pittsburgh Steel Co., Grant Bldg., Pittsburgh, Pa.
Revere Copper & Brass, Inc., 230 Park Ave., New York City
Scovill Mfg. Co., Waterbury, Conn.
Steel & Tubes Division, Republic Steel Corp., Cleveland, Ohio
Timken Roller Bearing Co. (Steel and Tube Div., Canton, Ohio
Whitlock Mfg. Co., The, Hartford, Conn.
Wolverine Tube Div., 1411 Central Ave., Detroit, Mich.

TUBES—Corrosion-Resisting:
Allegheny Ludlum Steel Corp., Brackenridge, Pa.
Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
American Brass Co., 25 Broadway, New York City
Babcock & Wilcox Tube Co., The, 85 Liberty St., New York City
Brown Fintube Co., The, Elyria, Ohio
Burgess-Parr Co., Freeport, Ill.
Calorizing Co., The, Wilkinsburg Station, Pittsburgh, Pa.
Carpenter Steel Co., Kenilworth, N. J.
Chase Brass & Copper Co., Waterbury, Conn.
Duraloy Co., The, Scottdale, Pa.
Globe Steel Tubes Co., Milwaukee, Wis.
Haveg Corp., 919 N. Michigan, Chicago, Ill.
Haynes Stellite Co., Kokomo, Ind.
Kellogg Co., The M. W., 225 Broadway, New York City
National Carbon Co., Inc., Cleveland, Ohio
National Tube Co., Box 266, Pittburgh, Pa.
Ohio Steel Foundry Co., The, Springfield, Ohio
Pittsburgh Steel Co., Grant Bldg., Pittsburgh, Pa.
Revere Copper & Brass, Inc., 230 Park Ave., New York City
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Steel & Tubes Division, Republic Steel Corp., Cleveland, Ohio
Timken Roller Bearing Co. (Steel and Tube Div.), Canton, Ohio
Wolverine Tube Div., 1411 Central Ave., Detroit, Mich.
Youngstown Sheet & Tube Co., The, Youngstown, Ohio

TUBES—Cracking-Still:
Babcock & Wilcox Tube Co., The, 85 Liberty St., New York City
Bethlehem Steel Co., Bethlehem, Pa.
Calorizing Co., The, Wilkinsburg Station, Pittsburgh, Pa.
Globe Steel Tubes Co., Milwaukee, Wis.
Kellogg Co., The M. W., 225 Broadway, New York City
National Tube Co., Box 266, Pittsburgh, Pa.
Pittsburgh Steel Co., Grant Bldg., Pittsburgh, Pa.
Timken Roller Bearing Co. (Steel and Tube Div.), Canton, Ohio

TUBES—Finned:
Brown Fintube Co., The, Elyria, Ohio
Chase Brass & Copper Co., Waterbury Conn.
Globe Steel Tubes Co., Milwaukee, Wis.
Griscom-Russell Co., The, 285 Madison Ave., New York City
Schutte & Koerting Co., Philadelphia, Pa
Wolverine Tube Div., 1411 Central Ave., Detroit, Mich.
Zallea Bros. & Johnson, Wilmington, Del.

TUBES—Heat Exchanger—See TUBES, Condenser:

TUBES—Pyrometer:
Bristol Co., The, Waterbury, Conn.
Brown Instrument Div., Wayne and Windrum Aves., Philadelphia, Pa.
Carborundum Co., Niagara Falls, N. Y.
Duraloy Co., The, Scottdale, Pa.
Englehard, Charles, Inc., Newark, N. J.
Globe Steel Tubes Co., Milwaukee, Wis.
Greiner, Emil, Co., 55 Van Dam St., New York City
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.
National Carbon Co., Inc., Cleveland, Ohio
Norton Co., Worcester, Mass.
Ohio Steel Foundry Co., The, Springfield, Ohio
Presesed Steel Co., The Wilkes-Barre, Pa.

TUBES—Seamless Steel:
Allegheny Ludlum Steel Corp., Brackenridge, Pa.
Babcock & Wilcox Tube Co., The, 85 Liberty St., New York City
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Engineers & Fabricators, Inc., Houston, Tex.
Globe Steel Tubes Co., Milwaukee, Wis.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
National Tube Co., Box 266, Pittsburgh, Pa.
Ohio Seamless Tube Co., Shelby, Ohio
Pittsburgh Piping & Equipment Co., 10-43rd St., Pittsburgh, Pa.
Pittsburgh Steel Co., Grant Bldg., Pittsburgh, Pa.
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Stewarts & Lloyds, Ltd., Glasgow, Scotland
Texas Pipe Bending Co., Houston, Tex.
Timken Roller Bearing Co. (Steel and Tube Div.), Canton, Ohio
Youngstown Sheet & Tube Co., The, Youngstown, Ohio

TUBING—Centrifugally Cast:
Ampco Metals, Inc., Milwaukee, Wis.
Bethlehem Steel Co., Bethlehem, Pa.
Burgess-Parr Co., Freeport, Ill.
Clow, James B., & Sons, 201 N. Talman, Chicago, Ill.
Duraloy Co., The, Scottdale, Pa.
Ohio Steel Foundry Co., The, Springfield, Ohio
Shenango-Penn Mold Co., Dover, Ohio
U. S. Pipe & Foundry Co., Burlington, N. J.

TUBING—Copper:
American Brass Co., 25 Broadway, New York City
Bridgeport Brass Co., Bridgeport, Conn.
Chase Brass & Copper Co., Waterbury, Conn.
Gilbert Brass Foundry Co., St. Louis, Mo.
Mueller Co., Decatur, Ill.
Pennsylvania Flexible Metallic Tubing Co., 72nd and Powers Lane, Philadelphia, Pa.
Revere Copper & Brass, Inc., 230 Park Ave., New York City
Scovill Mfg. Co., Waterbury, Conn.
Wolverine Tube Div., 1411 Central Ave., Detroit, Mich.

TUBING—Flexible, Metal:
American Brass Co., 25 Broadway, New York City
Atlantic Metal Hose Co., 123 West 64th St., New York City
Chicago Metal Hose Corp., Maywood, Ill.
Pennsylvania Flexible Metallic Tubing Co., 72nd and Powers Lane, Philadelphia, Pa.
Seamlex Co., Inc., 5-19 48th Ave., Long Island City, N. Y.

TUBING—High-Pressure, Flexible Metal:
American Brass Co., 25 Broadway, New York City
Chicago Metal Hose Corp., Maywood, Ill.
Pennsylvania Flexible Metallic Tubing Co., 72nd and Powers Lane, Philadelphia, Pa.

TUBING—Mechanical:
Allegheny Ludlum Steel Corp., Brackenridge, Pa.
American Brass Co., 25 Broadway, New York City
Babcock & Wilcox Tube Co., The, 85 Liberty St., New York City
Clayton Mark & Co., Evanston, Ill.
Globe Steel Tubes Co., Milwaukee, Wis.
National Tube Co., Box 266, Pittsburgh, Pa.
Ohio Seamless Tube Co., The, Shelby, Ohio
Pittsburgh Steel Co., Grant Bldg., Pittsburgh, Pa.
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
Steel & Tubes Division, Republic Steel Corp., Cleveland, Ohio
Stewarts & Lloyds, Ltd., Glasgow, Scotland
Timken Roller Bearing Co. (Steel and Tube Div.), Canton, Ohio

TUBING—Plastic:
Acadia Synthetic Products Div., Western Felt Works, Chicago, Ill.
Dow Chemical Co., The, Plastics Division Midland, Mich.

TUBING—Seamless, Flexible Metal:
American Brass Co., 25 Broadway, New York City
Atlantic Metal Hose Co., 123 West 64th St., New York City
Chicago Metal Hose Corp., Maywood, Ill.
Pennsylvania Flexible Metallic Tubing Co., 72nd and Powers Lane, Philadelphia, Pa.
Seamlex Co., Inc., 5-19 48th Ave., Long Island City, N. Y.
Zallea Bros. & Johnson, Wilmington, Del.

TUBING—Steel:
Allegheny Ludlum Steel Corp., Brackenridge, Pa.
Babcock & Wilcox Tube Co., The, 85 Liberty St., New York City
Bethlehem Steel Co., Bethlehem, Pa.
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Carpenter Steel Co., Kenilworth, N. J.
Flori Pipe Co., St. Louis, Mo.
Globe Steel Tubes Co., Milwaukee, Wis.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
National Tube Co., Box 266, Pittsburgh, Pa.
Pittsburgh Piping & Equipment Co., 10-43rd St., Pittsburgh, Pa.
Pittsburgh Steel Co., Grant Bldg., Pittsburgh, Pa.
South Chester Tube Co., Chester, Pa.
Steel & Tubes, Division, Republic Steel Corp., Cleveland, Ohio
Stewarts & Lloyds, Ltd., Glasgow, Scotland
Texas Pipe Bending Co., Houston, Tex.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., The, Youngstown, Ohio

TUBING—Steel, Seamless:
Allegheny Ludlum Steel Corp., Brackenridge, Pa.
Babcock & Wilcox Tube Co., The, 85 Liberty St., New York City
Bethlehem Steel Co., Bethlehem, Pa.
Bros, Wm., Boiler & Mfg. Co., Minneapolis, Minn.
Globe Steel Tubes Co., Milwaukee, Wis.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
National Tube Co., Box 266, Pittsburgh, Pa.
Ohio Seamless Tube Co., The, Shelby, Ohio
Pittsburgh Steel Co., Grant Bldg., Pittsburg, Pa.
Ryerson, Jos. T., & Sons, 2558 W. 16th St., Chicago, Ill.
South Chester Tube Co., Chester, Pa.
Spang Chalfant Div. (The National Supply Co.), Pittsburgh, Pa.
Stewarts & Lloyds, Ltd., Glasgow, Scotland
Texas Pipe Bending Co., Houston, Tex.

Timken Roller Bearing Co. (Steel and Tube Div.), Canton, Ohio
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., The, Youngstown, Ohio

TURBINES—Deep-Well—See Pumps, Turbine, Deep-Well

TURBINES—Gas:
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Coppus Engineering Corp., Worcester, Mass.
Elliott Co., Springfield, Ohio
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.
Terry Steam Turbine Co., The, Hartford, Conn.

TURBINES—Steam:
Allen, W. H., Sons & Co., Ltd., Bedford, England
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Carling Turbine Blower Co., Worcester, Mass.
Coppus Engineering Co., Worcester, Mass.
Dean Hill Pump Co., Anderson, Ind.
DeLaval Steam Turbine Co., Trenton, N. J.
Elliott Co., Springfield, Ohio
General Electric Co., Schenectady, N. Y.
Moon Manufacturing Co., 122 North Jefferson, Chicago, Ill.
Murray Iron Works Co., Burlington, Iowa
Pyle National Co., 1334 North Kostner, Chicago, Ill.
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.
Terry Steam Turbine Co., The, Hartford, Conn.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

TURNBUCKLES:
Bethlehem Steel Co., Bethlehem, Pa.
Glover Bros., Ltd., London, England
Laughlin, Thomas, Co., Portland, Me.
Mosher Steel Co., Houston, Tex.
Oil Well Supply Co., Dallas, Tex.
St. Louis Screw & Bolt Co., St. Louis, Mo.
Sheffield Steel Corp., Kansas City, Mo.

TURBO — Generators — See GENERATOR UNITS, Turbine-Driven

UNIONS—Ball Joint:
Belfield, H., Co., Philadelphia, Pa.
Dart, E. M., Manufacturing Co., Providence, R. I.
Fairbanks Co., The, 393 Lafayette St., New York City
Flagg, Stanley G., & Co., 1421 Chestnut St., Philadelphia, Pa.
Jarecki Mfg. Co., St. Louis, Mo.
Morrison Brothers, Dubuque, Iowa
Rhode Island Fittings Co., Hillsgrove, R. I.
Walworth Co., 60 East 42nd St., New York City

UNIONS—Drop Forged Steel:
Vogt, Henry, Machine Co., Louisville, Ky.

UNIONS—Flange, Gasket-Type:
Belfield, H., Co., Philadelphia, Pa.
Chase Brass & Copper Co., Waterbury, Conn.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Flagg, Stanley G., & Co., 1421 Chestnut St., Philadelphia, Pa.
Jarecki Mfg. Co., St. Louis, Mo.
Kennedy Valve Mfg. Co., The, Elmira, N. Y.
Kerotest Mfg. Co., 2525 Liberty Ave., Pittsburgh, Pa.
Pittsburgh Valve & Fittings Corp., Barberton, Ohio
Rhode Island Fittings Co., Hillsgrove, R. I.
Walworth Co., 60 East 42nd St., New York City
Watson-Stillman Co., Fitting Div., Roselle, N. J.
Westinghouse Air Brake Co., Wilmerding, Pa.

UNIONS—Flange, Ground Joint:
Belfield, H., Co., Philadelphia, Pa.
Chase Brass & Copper Co., Waterbury, Conn.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Dart, E. M., Manufacturing Co., Providence, R. I.
Fairbanks Co., The, 393 Lafayette St., New York City
Flagg, Stanley G., & Co., 1421 Chestnut St., Philadelphia, Pa.
Frick Co., Waynesboro, Pa.
Gaso Pump & Burner Mfg. Co., Tulsa, Okla.
Jarecki Mfg. Co., St. Louis, Mo.
Jefferson Union Co., New York City
Kennedy Valve Mfg. Co., The, Elmira, N. Y.
Pittsburgh Valve & Fittings Corp., Barberton, Ohio
Rhode Island Fittings Co., Hillsgrove, R. I.
Walworth Co., 60 East 42nd St., New York City
Watson-Stillman Co., Fitting Div., Roselle, N. J.

UNIONS—Flange, Tongue-and-Groove Joint:
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Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Frick Co., Waynesboro, Pa.
Gaso Pump & Burner Mfg. Co., Tulsa Okla.
Jarecki Mfg. Co., St. Louis, Mo.
Kerotest Mfg. Co., 2525 Liberty Ave., Pittsburgh, Pa.
Walworth Co., 60 East 42nd St., New York City
Watson-Stillman Co., Fitting Div., Roselle, N. J.

UNIONS—Forged Steel:
Belfield, H., Co., Philadelphia, Pa.
Catawissa Valve & Fittings Co., Catawissa, Pa.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Flori Pipe Co., St. Louis, Mo.
Hadfields, Ltd., London, England
Mark, Clayton & Co., Evanston, Ill.
Newman, Hender & Co., Ltd., Woodchester, England
Thornhill-Craver Co., Houston, Tex.
Vogt, Henry, Machine Co., Louisville, Ky.
Walworth Co., 60 East 42nd St., New York City
Watson-Stillman Co., Fitting Div., Roselle, N. J.

UNIONS—Hammer, Lug:
Belfield, H., Co., Philadelphia, Pa.
Catawissa Valve & Fittings Co., Catawissa, Pa.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Flagg, Stanley G., & Co., 1421 Chestnut St., Philadelphia, Pa.
Watson-Stillman Co., Fitting Div., Roselle, N. J.

UNIONS—Quick-Change:
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Guiberson Corp., Dallas, Tex.
Mark, Clayton & Co., Evanston, Ill.
Thornhill-Craver Co., Houston, Tex.
Watson-Stillman Co., Fitting Div., Roselle, N. J.

UNIONS—Screw, Gasket-Type:
Belfield, H., Co., Philadelphia, Pa.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Detroit Brass & Malleable Works, 100 So. Campbell Ave., Detroit, Mich.
Flagg, Stanley G., & Co., 1421 Chestnut St., Philadelphia, Pa.
Jarecki Mfg. Co., St. Louis, Mo.
Kennedy Valve Mfg. Co., The, Elmira, N. Y.
Pittsburgh Valve & Fittings Corp., Barberton, Ohio
Rhode Island Fittings Co., Hillsgrove, R. I.
Thornhill-Craver Co., Houston, Tex.
Victaulic Co. of America, 30 Rockefeller Plaza, New York City
Walworth Co., 60 East 42nd St., New York City

UNIONS—Screw, Ground Joint:
Belfield, H., Co., Philadelphia, Pa.
Chase Brass & Copper Co., Waterbury, Conn.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Dart, E. M., Manufacturing Co., Providence, R. I.
Detroit Brass & Malleable Works, 100 So. Campbell Ave., Detroit, Mich.
Flagg, Stanley G., & Co., 1421 Chestnut St., Philadelphia, Pa.
Jarecki Mfg. Co., St. Louis, Mo.
Jefferson Union Co., 601 W. 26th St., New York City
Kennedy Valve Mfg. Co., The, Elmira, N. Y.
Pittsburgh Valve & Fittings Co., Hillsgrove, R. I.
Rockwood Sprinkler Co., Worcester, Mass.
Vogt, Henry, Machine Co., Louisville, Ky.
Walworth Co., 60 East 42nd St., New York City
Watson-Stillman Co., Fitting Div., Roselle, N. J.

V-BELT DRIVES—See DRIVES, V-belt

VACUUM PUMPS—See PUMPS, Vacuum

VACUUM COOLING EQUIPMENT:
Biggs Boiler Works, The, Akron, Ohio
Croll-Reynolds Engineering Co., Inc., 17 John St., New York City
Foster Wheeler Corp., 165 Broadway, New York City
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.

VACUUM GAUGES—See GAUGES, Vacuum:

VALVE CUPS—See CUPS, Valve:

VALVES—Acid-Resisting:
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American Manganese Steel Div., 389 E. 14th St., Chicago Heights, Ill.
Copper Alloy Foundry Co., The, Elizabeth, N. J.
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Duraloy Co., The, Scottdale, Pa.
Duriron Co., The, Inc., Dayton, Ohio
Edward Valve & Mfg. Co., East Chicago, Ind.
Goodrich, B. F., Co., Akron, Ohio
Haveg Corp., 919 North Michigan, Chicago, Ill.
Hills-McCanna, 2349 Nelson, Chicago, Ill.
Homestead Valve Mfg. Co., Coraopolis, Pa.
Jenkins Brothers, 80 White St., New York City
Knight, Maurice Co., The, Cincinnati, Ohio
Lunkenheimer Co., The, Cincinnati, Ohio
Merco Nordstorm Valve Co., Homewood, Pittsburgh, Pa.
National Lead Co., 111 Broadway, New York City
Newman, Hender & Co., Ltd., Woodchester, England
Ohio Injector Co., Wadsworth, Ohio
Ohio Steel Foundry Co., The, Springfield, Ohio
Pfaudler Co., The, Rochester, N. Y.
Pioneer Alloy Products Co., Cleveland, Ohio
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Clark Controller Co. 1146 East 152nd St., Cleveland, Ohio
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Crosby Steam Gage & Valve Co., 165 Broadway, New York City
Darling Valve & Mfg. Co., Williamsport, Pa.
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Fischer & Porter Co., Hatboro, Pa.
Fisher Governor Co., Marshalltown, Iowa
Foxboro Co., The, Foxboro, Mass.
Galland Henning Co., Milwaukee, Wis.
Grove Regulator Co., Oakland, Calif.
Hagan Corp., Hagan Bldg., Pittsburgh, Pa
Hills-McCanna, 2349 Nelson, Chicago, Ill.
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
Jenkins Brothers, 80 White St., New York City
Kennedy Valve Mfg. Co., The, Elmira, N. Y.
Kieley & Mueller, Inc., North Bergen, N. J.
Ludlow Valve Mfg. Co., Troy, N. Y.
McAlear Manufacturing Co., 1901 South Western, Chicago, Ill.
Mason-Neilan Regulator Co., Boston, Mass.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
National Machine Works, 1559 North Sheffield, Chicago, Ill.
Natural Gas Equipment, Inc., 714 West Olympic Blvd., Los Angeles, Calif.
Nicholson, W. H., & Co., Wilkes-Barre, Pa.
Porter, H. K., Co., Inc., Pittsburgh, Pa.
Powell, Wm., Co., The, Cincinnati, Ohio
Powers Regulator Co., 2720 Greenview Ave., Chicago, Ill.
Republic Flow Meters Co., Chicago, Ill.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Simplex Valve & Meter Co., 68th and Upland, Philadelphia, Pa.
Spence Engineering Co., Walden, N. Y.
Tagliabue, C. J., Mfg. Co., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. O., Co., Detroit, Mich.
Vogt, Henry, Machine Co., Louisville, Ky.
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Westinghouse Air Brake Co., Wilmerding, Pa.

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Fairbanks Co., The, 393 Lafayette St., New York City
Flori Pipe Co., St. Louis, Mo.
Frick Co., Waynesboro, Pa.
Hills-McCanna, 2439 Nelson, Chicago, Ill.
Hunt Tool Co., Houston, Tex.
Jarecki Mfg. Co., St. Louis, Mo.
Jenkins Brothers, 80 White St., New York City
Kennedy Valve Mfg. Co., The, Elmira, N. Y.
Kerotest Mfg. Co., 2525 Liberty Ave., Pittsburgh, Pa.
Kieley & Mueller, Inc., North Bergen, N. J.
Klingerit, Inc., 16 Hudson St., New York City
Lunkenheimer Co., The, Cincinnati, Ohio
Ludlow Valve Mfg. Co., Troy, N. Y.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Milwaukee Valve Co., Milwaukee, Wis.
Morrison Brothers, Dubuque, Iowa
Newman, Hender & Co., Ltd., Woodchester, England
Ohio Injector Co., Wadsworth, Ohio
Oil Well Supply Co., Dallas, Tex.
Pittsburgh Valve & Fittings Corp., Barberton, Ohio
Porter, H. K., Co., Inc., Pittsburgh, Pa.
Powell, Wm., Co., The, Cincinnati, Ohio
Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Reading, Pa.
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Strong, Carlisle & Hammond Co., The, 1392 West 3rd St., Cleveland, Ohio
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Zallea Bros. & Johnson, Wilmington, Del.

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Cash, A. W., Co., Decatur, Ill.
Chaplin-Fulton Mfg. Co., 28-40 Penn Ave., Pittsburgh, Pa.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago, Ill.
Detroit Brass & Malleable Works, 100 S. Campbell Ave., Detroit, Mich.
Edward Valve & Mfg. Co., East Chicago, Ind.
Fisher Governor Co., Marshalltown, Iowa
Foster Engineering Co., Newark, N. J.
Grove Regulator Co., Oakland, Calif.
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
Kennedy Valve Mfg. Co., The, Elmira, N. Y.
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McAlear Manufacturing Co., 1901 South Western, Chicago, Ill.
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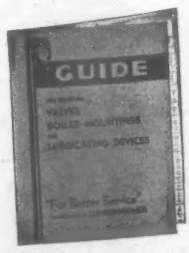

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Ohio Injector Co., Wadsworth, Ohio
Okadee Co., 332 South Michigan, Chicago,, Ill.
Powell, Wm., Co., The, Cincinnati, Ohio
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Reynolds Gas Regulator Co., Anderson, N. Y.
Walworth Co., 60 East 42nd St., New York City
Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.

VALVES—Breather—See VALVES, Tank, Vent

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Kennedy Valve Mfg. Co., The, Elmira, N. Y.
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Fisher Governor Co., Marshalltown, Iowa
Hagan Corp., Hagan Bldg., Pittsburgh, Pa.
Hanlon-Waters, Inc., Tulsa, Okla.
Jarecki Mfg. Co., St. Louis, Mo.
Ludlow Valve Mfg. Co., Troy, N. Y.
Mason-Neilan Regulator Co., Boston, Mass.
National Machine Works, 1559 N. Sheffield, Chicago, Ill.
Ohio Injector Co., Wadsworth, Ohio
Porter, H. K., Co., Pittsburgh, Pa.
Powell, Wm., Co., The, Cincinnati, Ohio
Republic Flow Meters Co., Chicago, Ill.
Ruggles Klingemann Mfg. Co., Salem, Mass.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Walworth Co., 60 East 42nd St., New York City

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Chapman Valve Mfg. Co., Indian Orchard, Mass.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Edward Valve & Mfg. Co., East Chicago, Ind.
Fairbanks Co., The 393 Lafayette St., New York City
Flori Pipe Co., St. Louis, Mo.
Hunt Tool Co., Houston, Tex.
Jarecki Mfg. Co., St. Louis, Mo.
Jenkins Brothers, 80 White St., New York City
Kennedy Valve Mfg. Co., The, Elmira, N. Y.
Kerotest Mfg. Co., 2525 Liberty Ave., Pittsburgh, Pa.
Lunkenheimer Co., The, Cincinnati, Ohio
McDonald, A. Y., Mfg. Co., Dubuque, Iowa
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Milwaukee Valve Co., Milwaukee, Wis.
National Machine Works, 1559 N. Sheffield, Chicago, Ill.
Newman, Hender & Co., Ltd., Woodchester, England
Ohio Injector Co., Wadsworth, Ohio
Pittsburgh Piping & Equipment Co., 10 43rd St., Pittsburgh, Pa.
Pittsburgh Valve & Fittings Corp., Barberton, Ohio
Powell, Wm., Co., The, Cincinnati, Ohio

Security Engineering Co., Inc., Whittier, Calif.
Strong, Carlisle & Hammond Co., The, 1392 West 3rd St., Cleveland, Ohio
Walworth Co., 60 East 42nd St., New York City
Watson-Stillman Co., Fitting Div., Roselle, N. J.

VALVES—Check, Ball:
Chase Brass & Copper Co., Waterbury, Conn.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Detroit Brass & Malleable Works, 100 S. Campbell Ave., Detroit, Mich.
Edward Valve & Mfg. Co., East Chicago, Ind.
Frick Co., Waynesboro, Pa.
Jarecki Mfg. Co., St. Louis, Mo.
Jenkins Brothers, 80 White St., New York City
Lunkenheimer Co., The, Cincinnati, Ohio
Milwaukee Valve Co., Milwaukee, Wis.
Newman, Hender & Co., Ltd., Woodchester, England
Pittsburgh Piping & Equipment Co., 10 43rd St., Pittsburgh, Pa.
Porter, H. K., Co., Inc., Pittsburgh, Pa.
Powell, Wm., Co., The, Cincinnati, Ohio
Walworth Co., 60 East 42nd St., New York City
Westinghouse Air Brake Co., Wilmerding, Pa.

VALVES—Check, Pision-Type:
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Daniel Orifice Fitting Co., Los Angeles, Calif.

VALVES—Check, Spring Loaded, Union End:
Mark, Clayton & Co., Evanston, Ill.

VALVES—Check, Swing:
Catawissa Valve & Fittings Co., Catawissa, Pa.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Chase Brass & Copper Co., Waterbury, Conn.
Connelly Iron Sponge & Governor Co., 3154 S. California, Chicago, Ill.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Darling Valve & Mfg. Co., Williamsport, Pa.
Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago, Ill.
Detroit Brass & Malleable Works, 100 S Campbell Ave., Detroit, Mich.
Fairbanks Co., The, 393 Lafayette St., New York City
Frick Co., Waynesboro, Pa.
Gaso Pump & Burner Mfg. Co., Tulsa, Okla.
Hanlon-Waters, Inc., Tulsa, Okla.
Jarecki Mfg. Co., St. Louis, Mo.
Jenkins Brothers, 80 White St., New York City
Kennedy Valve Mfg. Co., The, Elmira, N. Y.
Ludlow Valve Mfg. Co., Troy, N. Y.
Lunkenheimer Co., The, Cincinnati, Ohio
M & H Valve & Fittings Co., Anniston, Ala.
Milwaukee Valve Co., Milwaukee, Wis.
Mueller Co., Decatur, Ill.
National Machine Works, 1559 N. Sheffield, Chicago, Ill.
Newman, Hender & Co., Ltd., Woodchester, England
Ohio Injector Co., Wadsworth, Ohio
Pittsburgh Piping & Equipment Co., 10 43rd St., Pittsburgh, Pa.
Pittsburgh Valve & Fittings Corp., Barberton, Ohio
Porter, H. K., Co., Inc., Pittsburgh, Pa.
Powell, Wm., Co., The, Cincinnati, Ohio
Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Reading, Pa.
Security Engineering Co., Inc., Whittier, Calif.
Vapor Recovery Systems Co., The, Compton, Calif.
Walworth Co., 60 East 42nd St., New York City
Westinghouse Air Brake Co., Wilmerding, Pa.
Wheatley Brothers, Tulsa, Okla.

VALVES—Check, Vertical:
Catawissa Valve & Fittings Co., Catawissa, Pa.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Connelly Iron Sponge & Governor Co., 3154 S. California, Chicago, Ill.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Daniel Orifice Fitting Co., Los Angeles, Calif.
Detroit Brass & Malleable Works, 100 S. Campbell Ave., Detroit, Mich.
Edward Valve & Mfg. Co., East Chicago, Ind.
Fairbanks Co., The, 393 Lafayette St., New York City
Hunt Tool Co., Houston, Tex.
Jarecki Mfg. Co., St. Louis, Mo.
Jenkins Brothers, 80 White St., New York City
Kennedy Valve Mfg. Co., The, Elmira, N. Y.
Ludlow Valve Mfg. Co., Troy, N. Y.
Lunkenheimer Co., The, Cincinnati, Ohio
McDonald, A. Y., Mfg. Co., Dubuque, Iowa
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Newman, Hender & Co., Ltd., Woodchester, England
Ohio Injector Co., Wadsworth, Ohio
Oil Equipment Mfg. Co., Louisville, Ky.
Pittsburgh Valve & Fittings Corp., Barberton, Ohio
Powell, Wm., Co., The, Cincinnati, Ohio
Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Reading, Pa.
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Walworth Co., 60 East 42nd St., New York City

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Full Opening Check Valve

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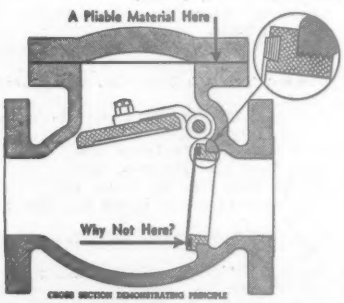

Patent Applied for

- The rubber ring conforms to all deposits and obstacles and makes it possible for this valve to seal under the worst conditions.
- Specified for gathering lines. Less pressure required for positive seal than with the metal to metal seal which depends entirely on pressure.
- The rubber ring, itself, can be replaced from our stock and no machine work is necessary for installation.
- In service two years without one complaint.
- No lapping or grinding of seats necessary.
- Absolutely silent in operation. Ideal for refineries and pumping stations where the slapping of metal check valve clappers is annoying.
- Seals regardless of viscosity. Operates equally well on kerosene or crude. Perfect for gasoline.
- Removable bronze seat ring, into which the rubber ring is inserted, can be replaced by the standard metal to metal seat, if desired.
- No additional charge for Synthetic Seal feature.

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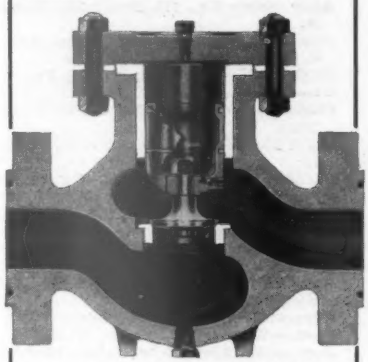

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Chaplin-Fulton Mfg. Co., 28-40 Penn Ave., Pittsburgh, Pa.
Connelly Iron Sponge & Governor Co., 3154 S. California, Chicago, Ill.
Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago, Ill.
Fisher Governor Co., Marshalltown, Iowa
Grinnell Co., Inc., Providence, R. I.
Hanlon-Waters, Inc., Tulsa, Okla.
Hills-McCanna, 2349 Nelson, Chicago, Ill.
Kerotest Mfg. Co., 2525 Liberty Ave., Pittsburgh, Pa.
Kieley & Mueller, Inc., North Bergen, N. J.
McAlear Mfg. Co., 1901 South Western, Chicago, Ill.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Mason-Neilan Regulator Co., Boston, Mass.
Mercoid Corp., 4201 Belmont, Chicago, Ill.
National Carbon Co., Inc., Cleveland, Ohio
National Tank Co., Tulsa, Okla.
Natural Gas Equipment, Inc., 714 W. Olympic Blvd., Los Angeles, Calif.
Pittsburgh Piping & Equipment Co., 10 43rd St., Pittsburgh, Pa.
Powers Regulator Co., 2720 Greenview Ave., Chicago, Ill.
Reynolds Gas Regulator Co., Anderson, Ind.
Ruggles Klingemann Mfg. Co., Salem, Mass.
Spence Engineering Co., Inc., Walden, N. Y.
Tagliabue, C. J., Mfg. Co., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice, H. O., Co., Detroit, Mich.
Vapor Recovery Systems Co., The, Compton, Calif.

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Cash, A. W., Co., Decatur, Ill.
Coy, Jos. A., Co., Inc., Tulsa, Okla.
Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago, Ill.
Foster Engineering Co., Newark, N. J.
Grove Regulator Co., Oakland, Calif.
Hanlon-Waters, Inc., Tulsa, Okla.
Kieley & Mueller, Inc., North Bergen N. J.
McAlear Mfg. Co., 1901 South Western, Chicago, Ill.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Mason-Neilan Regulator Co., Boston, Mass.
Merco Nordstrom Valve Co., Homewood, Pittsburgh, Pa.
Porter, H. K., Co., Inc., Pittsburgh, Pa.
Reynolds Gas Regulator Co., Anderson, Ind.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Spence Engineering Co., Inc., Walden, N. Y.
Swartwout Co., The, 18511 Euclid Ave., Cleveland, Ohio
Tagliabue, C. J., Mfg. Co., Brooklyn, N. Y.

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Jerguson Gage & Valve Co., Somerville, Mass.
Kerotest Mfg. Co., 2525 Liberty Ave., Pittsburgh, Pa.
Newman, Hender & Co., Ltd., Woodchester, England
Porter, H. K., Co., Pittsburgh, Pa.
Strong, Carlisle & Hammond Co., The, 1392 West 3rd, Cleveland, Ohio
Vogt, Henry, Machine Co., Louisville, Ky.
Zallea Bros. & Johnson, Wilmington, Del.

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Cutler-Hammer, Inc., Milwaukee, Wis.
Darling Valve & Mfg. Co., Williamsport, Pa.
Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago, Ill.
Edward Valve & Mfg. Co., East Chicago, Ind.
General Controls Co., Glendale, Calif.
Hills-McCanna, 2349 Nelson, Chicago, Ill.
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
Jenkins Brothers, 80 White St., New York City
Kennedy Valve Mfg. Co., The, Elmira, N. Y.
Kieley & Mueller, Inc., North Bergen, N. J.
Ludlow Valve Mfg. Co., Troy, N. Y.
Lunkenheimer Co., The, Cincinnati, Ohio
Merco Nordstrom Valve Co., Homewood, Pittsburgh, Pa.
Powell, Wm., Co., The, Cincinnati, Ohio
Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Reading, Pa.
Reed Roller Bit Co., Houston, Tex.
Ruggles Klingemann Mfg. Co., Salem, Mass.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Spence Engineering Co., Walden, N. Y.
Tagliabue, C. J., Mfg. Co., Rochester, N. Y.
Vogt, Henry, Machine Co., Louisville, Ky.
Walworth Co., 60 East 42nd St., New York City

VALVES—Float-Operated:

Atlas Valve Co., 276 South St., Newark, N. J.
Belfield, H., Co., Philadelphia, Pa.
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago, Ill.
Fisher Governor Co., Marshalltown, Iowa
Foster Engineering Co., Newark, N. J.
Frick Co., Waynesboro, Pa.
Hanlon-Waters, Inc., Tulsa, Okla.
Illinois Engineering Co., 21st and Racine, Chicago, Ill.
Kieley & Mueller, Inc., North Bergen, N. J.
Ludlow Valve Mfg. Co., Troy, N. Y.
McAlear Mfg. Co., 1901 South Western, Chicago, Ill.
McDonnell & Miller, Wrigley Bldg., Chicago, Ill.
Mason-Neilan Regulator Co., Boston, Mass.
McDonnell & Miller, Chicago, Ill.
Newman, Hender & Co., Ltd., Woodchester, England
Porter, H. K., Co., Inc., Pittsburgh, Pa.
Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Reading, Pa.
Ruggles Klingemann Mfg. Co., Salem, Mass.
R-S Products Corp., 110 Berkley St., Philadelphia, Pa.
Spence Engineering Co., Inc., Walden, N. Y.
Swartwout Co., The, 18511 Euclid Ave., Cleveland, Ohio
Trerice, H. O., Co., Detroit, Mich.

VALVES—Foot:

Chapman Valve Mfg. Co., Indian Orchard, Mass.
Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Jarecki Mfg. Co., St. Louis, Mo.
Jenkins Brothers, 80 White St., New York City
Ludlow Valve Mfg. Co., Troy, N. Y.
McDonald, A. Y., Mfg. Co., Dubuque, Iowa
Milwaukee Valve Co., Milwaukee, Wis.
National Airoil Burner Co., 1238 E. Sedgley Ave., Philadelphia, Pa.
Newman, Hender & Co., Ltd., Woodchester, England
Pittsburgh Valve & Fittings Corp., Barberton, Ohio
Porter, H. K., Co., Inc., Pittsburgh, Pa.
Walworth Co., 60 East 42nd St., New York City

VALVES—Forged Steel:

Chapman Valve Mfg. Co., Indian Orchard, Mass.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Darling Valve & Mfg. Co., Williamsport, Pa.
Edward Valve & Mfg. Co., East Chicago, Ind.
Jerguson Gage & Valve Co., Somerville, Mass.
Klinger, Richard, Ltd., Sidcup (Kent) England
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Newman, Hender & Co., Ltd., Woodchester, England.
Pittsburgh Piping & Equipment Co., 10 43rd St., Pittsburgh, Pa.
Porter, H. K., Co., Inc., Pittsburgh, Pa.
Strong, Carlisle & Hammond Co., The, 1392 West 3rd., Cleveland, Ohio
Vogt, Henry, Machine Co., Louisville, Ky.
Watson-Stillman Co., Fitting Div., Roselle, N. J.
Zallea Bros & Johnson, Wilmington, Del.

VALVES—Gate:

Alloy Steel Products Co., Inc., Linden, N. J.
Bayard, M. L. & Co., Inc., Philadelphia, Pa.
Chapman Valve Mfg., Co., Indian Orchard, Mass.
Chase Brass & Copper Co., Waterbury Conn.

Cooper Alloy Foundry Co., Hillside, N. J.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Darling Valve & Mfg. Co., Williamsport, Pa.
Detroit Brass & Malleable Works, 100 S. Campbell Ave., Detroit, Mich.
Everlasting Valve Co., Jersey City, N. J.
Fairbanks Co., The, 393 Lafayette St., New York City
Flori Pipe Co., St. Louis, Mo.
Jarecki Mfg. Co., St. Louis, Mo.
Jenkins Brothers, 80 White St., New York City
Kennedy Valve Mfg. Co., The, Elmira, N. Y.
Kerotest Mfg. Co., 2525 Liberty Ave., Pittsburgh, Pa.
Koppers Co., Koppers Bldg., Pittsburgh, Pa.
Ludlow Valve Mfg. Co., Troy, N. Y.
Lunkenheimer Co., The, Cincinnati, Ohio
McDonald, A. Y., Mfg. Co., Dubuque, Iowa
M & H Valve & Fittings Co., Anniston, Ala.
Manistee Iron Works, Manistee, Mich.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Milwaukee Valve Co., Milwaukee, Wis.
Mueller Co., Decatur, Ill.
National Machine Works, 1559 N. Sheffield, Chicago, Ill.
Newman, Hender & Co., Ltd., Woodchester, England
Ohio Injector C., Wadsworth, Ohio
Oil Well Supply Co., Dallas, Tex.
Pittsburgh Valve & Fittings Corp., Barberton, Ohio
Porter, H. K., Co., Inc., Pittsburgh, Pa.
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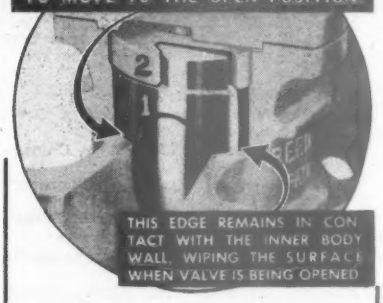

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Hunt Tool Co., Houston, Tex.
Inferno Co., Shreveport, La.
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Kerotest Mfg. Co., 2525 Liberty Ave., Pittsburgh, Pa.
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Lunkenheimer Co., The, Cincinnati, Ohio
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Merco Nordstrom Valve Co., Homewood Pittsburgh, Pa.
Nathan Mfg. Co., 416 East 106th St., New York City
Newman, Hender & Co., Ltd., Woodchester, England
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Powell Wm., Co., The, Cincinnati, Ohio
Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.

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Alloy Steel Products Co., Inc., Linden, N. J.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
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Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Detroit Brass & Malleable Works, 100 S. Campbell Ave., Detroit, Mich.
Edward Valve & Mfg. Co., East Chicago, Ind.
Fairbanks Co., The, 393 Lafayette St., New York City
Flori Pipe Co., St. Louis, Mo.
Frick Co., Waynesboro, Pa.
Hunt Tool Co., Houston, Tex.
Jarecki Mfg. Co., St. Louis, Mo.
Jenkins Brothers, 80 White St., New York City
Kennedy Valve Mfg. Co., The, Elmira, N. Y.
Kerotest Mfg. Co., 2525 Liberty Ave., Pittsburgh, Pa.
Klingerit, Inc., 16 Hudson St., New York City
Lunkenheimer Co., The, Cincinnati, Ohio
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Milwaukee Valve Co., Milwaukee, Wis.
Newman, Hender & Co., Ltd., Woodchester, England
Ohio Injector Co., Wadsworth, Ohio
Oil Well Supply Co., Dallas, Tex.
Pittsburgh Piping & Equipment Co., 10 43rd St., Pittsburgh, Pa.
Pittsburgh Valve & Fittings Corp., Barberton, Ohio
Porter, H. K., Co., Inc., Pittsburgh, Pa.
Powell Wm., Co., The, Cincinnati, Ohio
Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Reading, Pa.
Security Engineering Co., Inc., Whittier, Calif.
Strong, Carlisle & Hammond Co., The, 1392 West 3rd St., Cleveland, Ohio
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Vogt, Henry, Machine Co., Louisville, Ky.
Walworth Co., 60 East 42nd St., New York City
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Chapman Valve Mfg. Co., Indian Orchard, Mass.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Darling Valve & Mfg. Co., Williamsport, Pa.
Davis Regulator Co., 2541 S. Washtenaw Ave., Chicago, Ill.
Foster Engineering Co., Newark, N. J.
Galland Henning Co., Milwaukee, Wis.
Gato Valve Co., 1430 Oliver Bldg., Pittsburgh, Pa.
General Controls Co., Glendale, Calif.
Hanlon-Waters, Inc., Tulsa, Okla.
Jenkins Brothers, 80 White St., New York
Kennedy Valve Mfg. Co., The, Elmira, N. Y.
Kieley & Mueller, Inc., North Bergen, N. J.
Ludlow Valve Mfg. Co., Troy, N. Y.
McAlear Mfg. Co., 1901 South Western, Chicago, Ill.
McDonnell & Miller, Wrigley Bldg., Chicago, Ill.
M & H Valve & Fittings Co., Anniston, Ala.
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Mason-Neilan Regulator Co., Boston, Mass
Merco Nordstrom Valve Co., Homewood, Pittsburgh, Pa.
National Machine Works, 1559 N. Sheffield, Chicago, Ill.
Pittsburgh Piping & Equipment Co., 10 43rd St., Pittsburgh, Pa.
Porter, H. K., Co., Inc., Pittsburgh, Pa.
Powell, Wm., Co., The, Cincinnati, Ohio
Ruggles Klingemann Mfg. Co., Salem, Mass.
Vogt, Henry, Machine Co., Louisville, Ky.
Walworth Co., 60 East 42nd St., New York City

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Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Crosby Steam Gage & Valve Co., 165 Broadway, New York City
Darling Valve & Mfg. Co., Williamsport, Pa.
Everlasting Valve Co., Jersey City, N. J
Fairbanks Co., The, 393 Lafayette St., New York City
Hamer Oil Tool Co., Long Beach, Calif.
Hanlon-Waters, Inc., Tulsa, Okla.
Jarecki Mfg. Co., St. Louis, Mo.
Jenkins Brothers, 80 White St., New York City
Kennedy Valve Mfg. Co., The, Elmira, N. Y.
Klingerit, Inc., 16 Hudson St., New York City
M & H Valve & Fittings Co., Anniston, Ala.
Ludlow Valve Mfg. Co., Troy, N. Y.
Lunkenheimer Co., The, Cincinnati, Ohio
Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Merco Nordstrom Valve Co., Homewood Pittsburgh, Pa.

Mueller Co., Decatur, Ill.
National Machine Works, 1559 N. Sheffield, Chicago, Ill.
Newman, Hender & Co., Ltd., Woodchester, England
Ohio Injector Co., Wadsworth, Ohio
Okadee Co., 332 S. Michigan, Chicago, Ill
Pittsburgh Piping & Equipment Co., 10 43rd St., Pittsburgh, Pa.
Pittsburgh Valve & Fittings Corp., Barberton, Ohio
Powell, Wm., Co., The, Cincinnati, Ohio
Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Reading, Pa.
Reed Roller Bit Co., Houston, Tex.
Ruggles Klingemann Mfg. Co., Salem Mass.
Walworth Co., 60 East 42nd St., New York City
Wheatley Brothers, Tulsa, Okla.

VALVES—Lever-Operated:
Alloy Steel Products Co., Inc., Linden, N. J.
Atlas Valve Co., 276 South St., Newark, N. J.
Belfield, H., Co., Philadelphia, Pa.
Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.
Cash, A. W., Decatur, Ill.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.,
Darling Valve & Mfg. Co., Williamsport, Pa.
Davis Regulator Co., 2541 Washtenaw Ave., Chicago, Ill.
Everlasting Valve Co., Jersey City, N. J
Fairbanks Co., The, 393 Lafayette St., New York City
Fisher Governor Co., Marshalltown, Iowa
Foster Engineering Co., Newark, N. J.
Galland Henning Co., Milwaukee, Wis.
Hamer Oil Tool Co., Long Beach, Calif.
Hanlon-Waters, Inc., Tulsa, Okla.
Hills-McCanna, 2349 Nelson, Chicago, Ill.
Jarecki Mfg. Co., St. Louis Mo.
Jenkins Brothers, 80 White St., New York City
Jerguson Gage & Valve Co., Somerville, Mass.
Kennedy Valve Mfg. Co., The, Elmira, N. Y.
Kieley & Mueller, Inc., North Bergen, N. J.
Klingerit, Inc., 16 Hudson St., New York City
Ludlow Valve Mfg. Co., Troy, N. Y.
Lunkenheimer Co., The, Cincinnati, Ohio
McAlear Mfg. Co., 1901 South Western, Chicago, Ill.
McDonald, A. Y., Mfg. Co., Dubuque, Iowa
M & H Valve & Fittings Co., Anniston, Ala.
Mason-Neilan Regulator Co., Boston, Mass
Merco Nordstrom Valve Co., Homewood, Pittsburgh, Pa.
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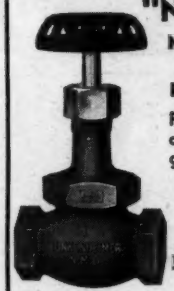

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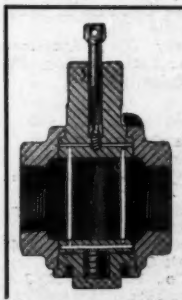

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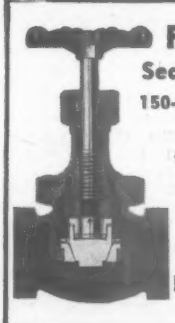

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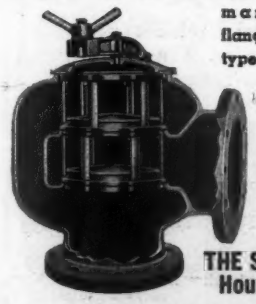
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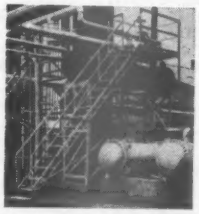

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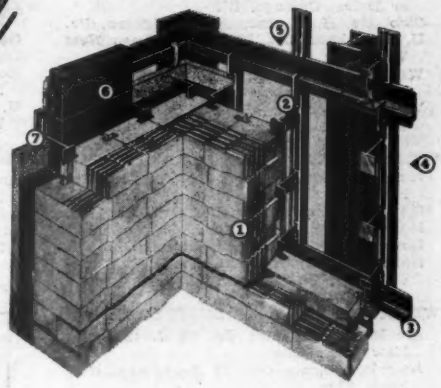

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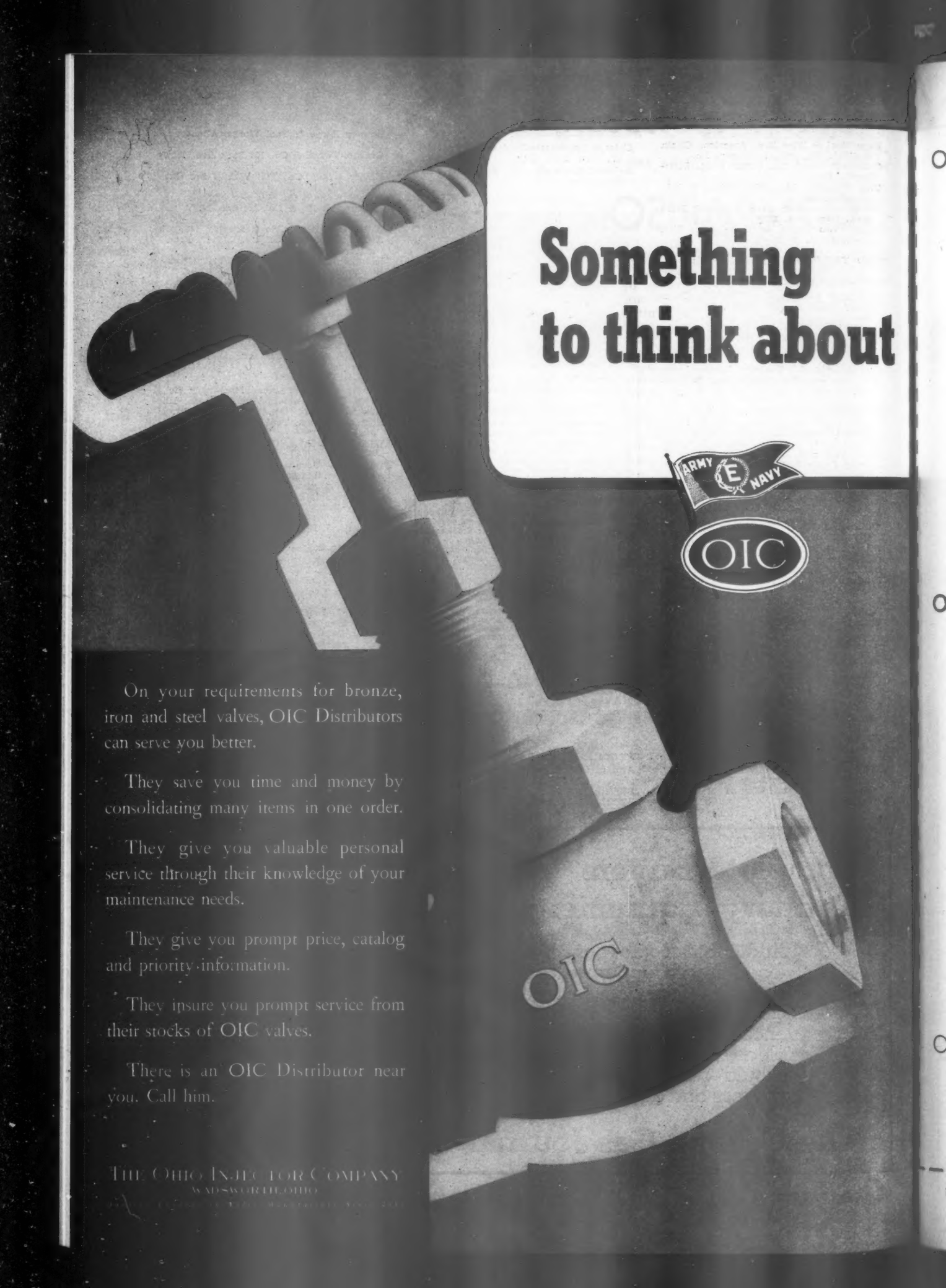
The Oil and Gas Journal **Tulsa, Oklahoma**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COMPARISON BY CAPITALIZED COST

IN the selection of oil-field equipment, present worth is generally used as a method of comparison. In such comparisons, two methods are possible—either the present worths of the expected costs of providing service for a limited number of years may be compared, or the present worths of the costs of perpetual service may be compared. The latter is known as the method of capitalized cost.

The first is the generally accepted method for the valuation of either developed or undeveloped properties which provide income for a limited number of years. However, it is often misleading if used as a method of evaluating equipment which must be replaced after a limited period of use in order to perpetuate the income brought about by the use of the equipment. The latter method must therefore be used as the basis of comparison in the selection of equipment.

Both of the above-mentioned present worth methods involve the assumption that the types of equipment being compared are renewed at the end of the service life at the same prices which prevailed at the time the comparison was made. This is an artificial assumption but it may be defended on the ground that no better assumption can be made and that as errors in costs some distance in the future are reduced and their present worths determined, the chances that they would reverse a present choice between two alternatives are small. In any case, it is necessary to make some assumption as to the recurrent investment costs if present worth methods are to be used, and it should be recognized that no estimator actually contemplates that future renewals will be exact duplicates of present installations or that they will take place at present costs.

Illustrative Problem

The following problem illustrates the way in which comparisons may be made by present worths of service for a limited number of years, and by capitalized cost.

A Gulf Coast drilling contractor desires to purchase a large steam rig for use in drilling deep wells. He is offered the following two rigs and wishes to compare them using an interest rate of 6 per cent.

Rig A has a first cost of $100,000 and an estimated life of 4 years with an estimated salvage value of $20,000 at the end of that time. It is further estimated that the average annual expenditure for operation, maintenance, taxes and insurance will be $117,500.

Rig B has a first cost of $70,000 and an estimated life of 4 years with an estimated salvage value of $17,000 at the end of that time. It is estimated that the average annual expenditure for operation, maintenance, taxes and insurance will be $125,000.

COMPARISON BY PRESENT WORTH OF COST OF SERVICE FOR A LIMITED PERIOD. Since the initial cost is already a present payment, it is merely necessary to convert the annual expenditures and the salvage value to their respective present worths.

The present worth factor for uniform annual expenditure used in Part 1 of the problem may be calculated from the following formula:

$$P = \frac{(1+i)^n - 1}{i(1+i)^n}$$

where P is the present worth factor, i is the interest rate, and n is the period of years over which service is to be obtained.

The present worth factor for single payment used to determine the present worth of the salvage value in Part 1 of the problem may be calculated from the formula:

$$S = \frac{1}{(1+i)^n}$$

where S is the present worth factor, i is the interest rate, and n is the number of years.

RIG A

First cost	=	$100,000
Present worth of annual expenditures for 4 years = $117,500 (3.465)	=	407,138
Present worth of salvage value at end of 4 years = $20,000 (0.7921)	=	—15,842
Total present worth of cost of 4 years' service		$491,296

RIG B

First cost	=	$70,000
Present worth of annual expenditures for 4 years = $125,000 (3.465)	=	433,125
Present worth of salvage value at end of 4 years = $17,000 (0.7921)	=	—13,466
Total present worth of cost of 4 years' service		$489,659

With interest at 6 per cent, Rig B shows a prospective savings of $1,637 in the present worth of the cost of 4 years' service.

COMPARISON BY CAPITALIZED COST: In order to calculate capitalized cost, it is necessary to make the assumption that the expenditures estimated for the first 4 years will repeat themselves in the succeeding 4-year periods. This means that selecting Rig A involves spending $100,000 immediately and every fourth year thereafter, and also spending $117,500 every year. Similar assumptions are made for Rig B. The comparison is:

The capitalized cost factor used in Part 2 of the illustrative problem is in reality a sinking fund factor. In other words, this factor is used to obtain the amount of money which, if placed in a sinking fund at a given interest rate, will amount to enough at the end of a given period of years to equal the first cost of the particular piece of equipment desired. It is obtained by the following formula:

RIG A

First cost	=	$100,000
Present worth of infinite series of renewals = $100,000 (0.22859) ÷ 0.06	=	380,968
Present worth of perpetual annual expenditures = $117,500 ÷ 0.06	=	1,958,333
Present worth of infinite series of salvages = $20,000 (0.22859) ÷ 0.06	=	—76,197
Total capitalized cost		$2,263,124

RIG B

First cost	=	$70,000
Present worth of infinite series of renewals = $70,000 (0.22859) ÷ 0.06	=	266,688
Present worth of perpetual annual expenditures = $125,000 ÷ 0.06	=	2,083,333
Present worth of infinite series of salvages = $17,000 (0.22859) ÷ 0.06	=	—64,772
Total capitalized cost		$2,355,049

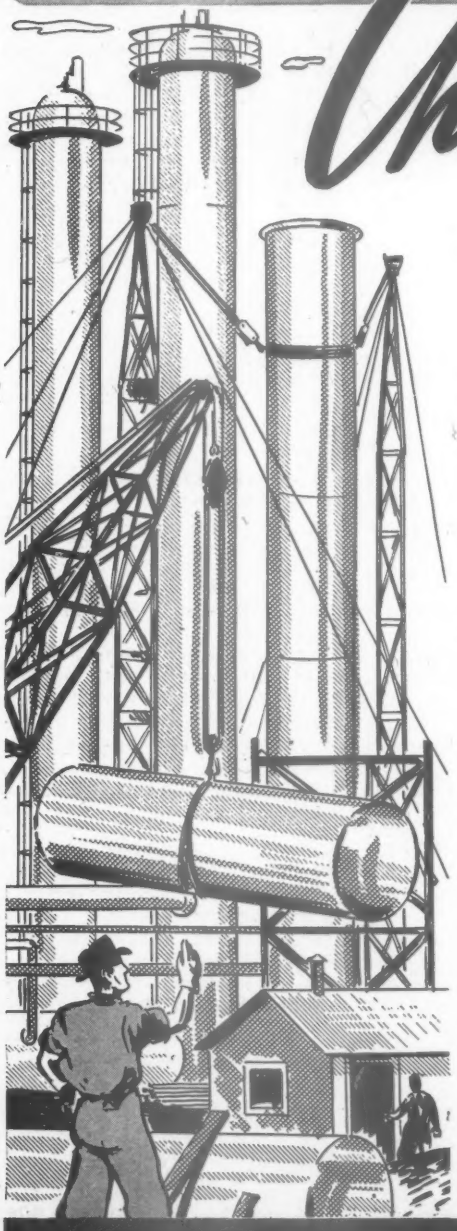
Rig A thus shows a prospective savings of $91,925 in capitalized cost.

$$C = \frac{i}{(1+i)^n - 1}$$

Reference

Grant, E. L., "Principles of Engineering Economy," Ronald Press Co., New York.

Let's talk over that Change-Over



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Engineering Fundamentals No. 77

A WEEKLY FEATURE OF THE OIL AND GAS JOURNAL

VOLUMETRIC EFFICIENCY OF GAS COMPRESSORS

THE volumetric efficiency of a compressor may be defined as the ratio of the volume of gas actually handled (measured at intake pressure and temperature) to the total volume displaced by the compressor piston in the same period of time. The volumetric efficiency of any compressor is always below 100 per cent and is a function of the clearance ratio, the pressure ratio, and the exponent of compression.

Clearance ratio in compressor work means the ratio of the **clearance** volume to the displacement volume. By the term clearance is meant the volume of space enclosed between the cylinder wall, piston face, and valves when the piston is at its dead center position for the given end of the cylinder.

The term **displacement volume** refers to the volume of that part of the cylinder that is swept through by the piston during one stroke, i.e., it represents the product of the cross-sectional area of the cylinder and the length of the piston stroke.

The volumetric efficiency decreases with an increase in pressure ratio when the clearance ratio is constant. This means that if the discharge pressure is increased while the intake pressure remains unchanged the volumetric efficiency is reduced. Also, if intake pressure is lowered without a change in the discharge pressure the volumetric efficiency will be reduced. The effects of these changes in pressure ratio on the volumetric efficiency are illustrated in the P-V diagrams of Figs. 1 and 2. In Fig. 1, the diagram abcd represents the relationship between pressure and volume before raising the discharge pressure, while the diagram a'b'c'd' represents the P-V relationship after raising the discharge pressure. Similarly, the diagram abcd in Fig. 2 represents the P-V relationship existing before a lowering of the intake pressure, while the diagram a'b'c'd' represents the P-V relationship after a lowering of the intake pressure. In both Fig. 1 and Fig. 2 the displacement volume (D.V.) and the clearance volume (C.V.) remain unchanged with the change in pressure ratio. In both cases, it will be noted that the intake line ab is shortened because the clearance gas must expand through a greater pressure range before the pressure in the cylinder space is lowered sufficiently to allow the intake valve to open. Then in Fig. 1, since a'b is less than ab the volumetric efficiency a'b/D.V. Similarly, in Fig 2, a'b'/D.V. is less than ab/D.V.

In Fig. 3 is illustrated the effect that an increase in the clearance has upon the volumetric efficiency when the pressure ratio remains unchanged. The P-V diagram abcd represents the condition existing when the clearance volume is c_1 and the diagram a'bc'd represents the relationship existing when the clearance volume has been increased to some value C_2. In the second case the larger volume of gas remaining in the cylinder at the end of the piston stroke (point d) will expand to a larger volume before the pressure is reduced to that of the intake. The line ab represents the volume of gas taken in with the smaller clearance volume, while the line a'b represents a smaller quantity of gas taken in when the clearance volume is greater. Thus, the volumetric efficiency, a'b/D.V., in the second case will be less than the volumetric efficiency, ab/D.V. in the first case.

From theoretical considerations involving an analysis of an ideal P-V diagram, the following equation for volumetric efficiency can be derived,

$$E_v = 1 - c(R^{1/n} - 1) \qquad (1)$$

where

E_v = volumetric efficiency, a fraction
c = clearance ratio, a fraction
R = ratio of absolute discharge pressure to absolute intake pressure
n = exponent of compression*

Gill† reports that tests on compressors have indicated that a more accurate relationship under average conditions is,

$$E_v = 0.98 - c(R^{1/n} - 1) \qquad (2)$$

Where all terms are defined as in equation (1).

Example

Problem:

What is the volumetric efficiency of a gas compressor having a clearance ratio of 10 per cent, when compressing gas from 50 lb. per sq. in., abs., to 200 lb. per sq. in., abs., if the exponent of compression is 1.2?

Solution:

$$R = 200/50 = 4$$

When $R = 4$, and $n = 1.2$,

$$(R^{1/n} - 1) = 2.175$$

Substituting in equation (2),

$$E_v = 0.98 - 0.10\ (2.175) = 0.7625,$$

or 76.25%

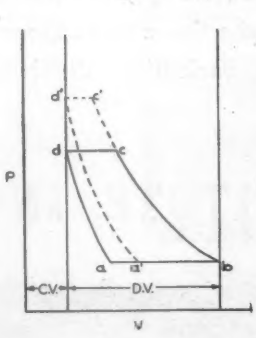

Fig. 1

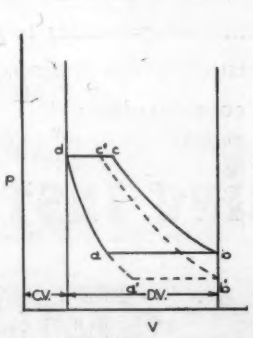

Fig. 2

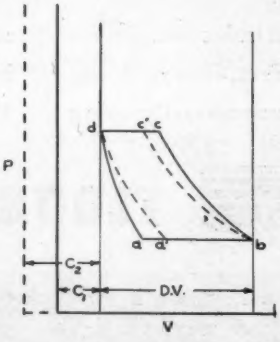

Fig. 3

*See Installments 74 and 76.

†Gill, T. T., "Air and Gas Compression," John Wiley & Sons, 1941.

Series prepared by Glenn M. Stearns, associate professor of petroleum engineering, University of Oklahoma

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OPERATING IDEAS

Home-Made Rod-Line Swing for Pumping Hookup

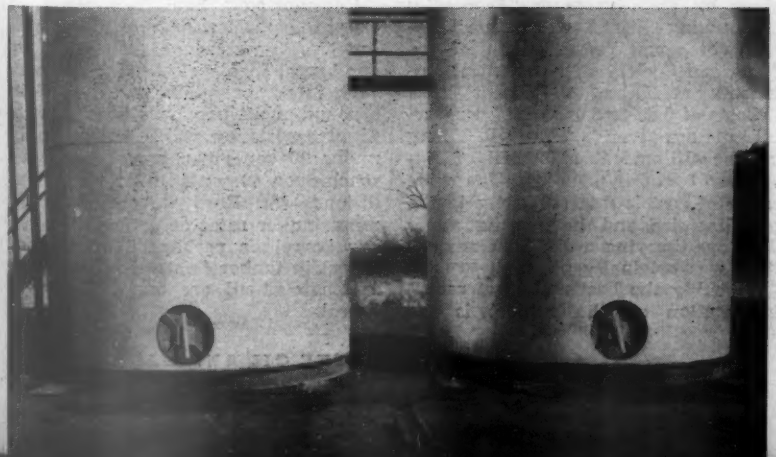
A 90° ROD-LINE swing in a central-power pumping hookup on a stripper lease is constructed of an old hub and three short lengths of old 5½-in. casing, which form the angle. A pipe set vertically in the ground and embedded in a concrete base serves as the axle for the hub. The top of the axle is secured with a guy line equipped with a turnbuckle connection for tightening.

Supplemental Engine Tie-down

THE usual method of fastening the drawworks engine to the foundation or substructure by means of bolts pulling against a pipe crossmember just below the floor subjects the rivets or bolts in the substructure to heavy stresses and tends to loosen the fastenings and introduce a source of destructive vibration. To reinforce the usual tie-down, one contractor places a joint of drill pipe below the derrick sills, tying this pipe to the one carrying the engine bolts with short lengths of heavy chain and turnbuckles. By tightening the turnbuckles, any desired amount of the load carried by the upper pipe may be transferred to the subsill member, and riveted structure relieved of vibration.

Guard Railing Used As Tool Rack

THE guard railing around this derrick floor is being used as a rack for miscellaneous tools and small pieces of equipment, eliminating the need of a separate tool rack and at the same time providing an unusually convenient, out-of-the-way place for such tools. The guard rail is constructed of piping to which are welded, or otherwise fastened, short metal pins for holding the tools, which hang suspended on them. Arrangement of the hangers can be varied to accommodate a wide assortment of tools.



Steel Support for Tank Bottoms

THESE 100-bbl. welded steel tanks do not require a solid foundation to prevent damage to the tank bottoms as they are set on frames made from channel irons. The frames rest directly on a few boards. To facilitate connection work, the foundation frames are built in two sections and pipes can be run under the tank without excavating.

QUESTIONS on TECHNOLOGY

by W. L. Nelson

Carbon Black Manufacture Not a Simple Operation

(Will 600 B.t.u. Gas Suffice?)

We have a lot of 600 B.t.u. gas and wonder if we couldn't arrange a crude way of making carbon black from this gas? Where can I get full information on the refining of this product? —R.O.B.

This is one of the many similar inquiries that have been received. Although the manufacture of carbon black appears to be a simple operation it certainly is not simple, and the total investment is large. Operations must be on a large scale to be profitable, large investments are required, slight differences in the physical properties of the black can make it unsatisfactory for most purposes (nor can these differences in properties be easily corrected), and the marketing of carbon black requires exceptiona business skill.

The late Dr. C. K. Francis, who operated this page for many years, stated: "There is so much residue gas available and the carbon black industry is finding it (so) difficult to market its production at a profit, that it appears unwise to attempt to manufacture this material from a poor quality gas." This statement was in reply to a query concerning the use of a 658 B.t.u. gas which contained 39.21% of nitrogen. It is quite probable that the temperature and flame conditions that would be produced by a low heating-value gas would not be suitable for the manufacture of the kinds of carbon black that are now being marketed. Although it is possible that special markets could be developed for the kind of carbon black that would be produced from a 600 B.t.u. gas, such a project would entail great expense and would require almost unlimited patience and faith in the project.

The subject has been discussed extensively in the trade magazines and in the two books (References 1 and 2) listed below.

References

1. Mattiello, "Protective and Decorative Coatings" Vol. 2, John Wiley and Sons, New York, 1942 (Chapter 20).
2. Ellis, C., "Chemistry of Petroleum Derivatives" Vo. 2, Reinhold Publishing Corp., New York, 1937 (Chapter 8).
3. Tulsa Public Library (Pet. Bibliography No. 8) entitled, "Carbon Black" (about 102 references).
4. Nelson, W. L. (this page) Furnace Black for Synthetic Rubber, The Oil and Gas Journal, March 11, 1943.
5. Reed, Paul, Texas Panhandle Center of Carbon Black Industry, The Oil and Gas Journal, page 12, Sept. 1, 1938.
6. Reid, Geo., Development in the Carbon Black Industry, 2 articles, Refiner & Natural Gaso. Mfg., March and April 1931.
7. Allen, Price and Reinbold, Manufacture of Carbon Black, The Oil and Gas Journal, June 20, 1935.
8. Moses, L., Review of Statutory Regulations . . ., The Oil and Gas Journal, April 9, 1942, page 30.

Cost of Oil Transportation

We desire statistical figures on the relative costs of water transportation and pipe-line transportation? — E. F. B.

Tanker rates as given by Stanley Norman on page 21 of The Oil and Gas Journal of April 8, 1937, are as follows:

Clean stocks—
Gulf Coast to N. Y. Harbor
41 cents/bbl. (1929)
23 cents/bbl. (1936)
35 cents/bbl. (1937)

Fuel oil—
Gulf Coast to N. Y. Harbor
45 cents/bbl. (1937)

In addition, rates to other points, such as Europe and the United Kingdom and from California to Japan or to New York are also given.

The cost of trunk-line transportation is said to range from 0.015 to 0.075 cents per barrel-mile by Professor Uren in Petroleum Production Engineering (Exploitation), page 672, second edition, McGraw-Hill Book Co., New York. The cost may range from about 0.011 to about 0.0524 cents per barrel-mile, according to figures given by Fritz Karge in "Economics of Pumping Oil at Low Friction Losses," which was presented before the American Society of Mechanical Engineers at Tulsa in October 1930.

Costs of 0.05 to 0.068 cents per barrel-mile are given by Frank R. Young in The Oil and Gas Journal of November 9, 1934, page 38. The wide range of cost is due primarily to the pipe-line size, and the fact that many lines are carrying a different amount than was originally planned.

Probably the best and most recent information on the subject is the January 7 article by Paul Reed on page 58 under the title, "Pipe Line Will Compete With Ocean Tankers." Mr. Reed states that the per barrel-mile cost is only 0.0003 cent for a modern, well-designed standard 12-in. trunk line operating under full capacity: and for the new 24-in. WEP line the cost will probably be as low as 0.0001 cent per barrel-mile. He stresses the prime importance of operating at full capacity; a decrease to 90 per cent or less of rated capacity increasing the cost disproportionately. It must be borne in mind that pipeline systems throughout the entire United States do not fit the needs of the average shipper as directly as does the WEP 24-in. line and that costs will be higher than in the 24-in. line and in many instances may be higher than the 0.0003 cent per barrel-mile given above.

The field charge for gathering crude oil into lease tanks and into central pumping stations is usually taken as 5 cents per barrel although in many instances the cost is actually much less.

The cost of trucking crude oil or refined products ranges widely due to the length of haul and whether a pay load can be carried in both directions. For gathering crude oil from numerous scattered small leases the cost may reach 5 cents per barrel-mile, whereas an average figure of ¾ cents per barrel-mile is given by Uren (p. 676).

A comparison of water and pipeline transportation costs cannot be given without stating a particular situation. For short hauls the pipe line is undoubtedly less expensive, and likewise a short pipe-line haul is cheaper than a long round-about water haul.

Considering a haul from the Gulf Coast to New York Harbor, the trunk-line cost could range from 13 cents per barrel in a well-designed line to even $1 per barrel for a heavy oil in a round-about poorly laidout system. Similar costs by water are probably under 20 cents per barrel but may reach even 40 cents under some conditions. Mr. Reed states that minimum tanker rates are about 16 cents per barrel or perhaps 22 cents per barrel in tanker fleets. Rail rates for this same haul are about $1.70 per barrel.

Natural Gasoline

Production Falls First Time Since April 1942

WASHINGTON, D. C.—A decrease of 11,000 bbl. in the daily average production of natural gasoline and allied products occurred in January, the Bureau of Mines reported here last week. The January decline was the first reversal of an upward-production trend since April 1942.

Outstanding decreases in January were reported from the Texas Panhandle, Louisiana and Oklahoma. Total production in Texas declined to 131,661,000 gal. in January (101,120 bbl. daily), compared with 139,868,000 gal. in December (107,405 bbl.). Production in January 1942, averaged 241,000 bbl. daily for the entire country.

The demand for all light products, the Bureau of Mines reported, decreased in January with consequent increases in stocks. Sales of liquefied petroleum gas, including liquefied refinery gas, totaled 48,678,000 gal. in January, which is 11 per cent below December but materially above January 1942, when demand totaled 35,364,000 gal. However, the Bureau explained, the January 1942, figure is probably low as that was the first month such data was collected and the returns were not complete.

PRODUCTION OF NATURAL GASOLINE AND ALLIED PRODUCTS
(Thousands of gallons)

Products—	Jan. 1943	Dec. 1942
Natural gasoline	157,332	170,058
Cycle products	58,800	57,834
Liquefied petroleum gas:		
Isobutane	12,054	10,332
L.P.G.	72,534	77,448
L.R.G.	18,438	20,160
Total	319,158	335,832

N.G.A.A. Issues New Volume Correction Bulletin

"N.G.A.A. Standard Factors for Volume Correction and Specific Gravity Conversion of Liquefied Petroleum Gases and Volatile Gasolines" has been completed by the technical committee of that association and is available in printed form at the association offices, Kennedy Building, Tulsa.

The data in this volume are based on the results of the experimental program carried out by the technical committee, reported in the annual proceeding of the association, May 1942, pages 11-22. The major number of corrections made in this bulletin are in the temperature range below 60° F., where lack of agreement between different tables in use by the industry heretofore has existed. Abridged Tables 1 and 2 give density values and temperature correction factors, respectively for light hydrocarbons. Data obtained by experimental study on hydrocarbons from minus 50° F. to 140° F. were employed to obtain the values given in Table 1. Table 3 and 4 expand the first two tables by graphical interpolation to 1° F. intervals, and with 0.005 specific gravity intervals.

California Production Over 45 Million Gallons

California natural-gasoline production in January 1943 totaled 45,613,002 gal. This production was obtained from 84 plants, which treated a total of more than 30 billion cubic feet of gas. Liquefied petroleum gas production amounted to 231,151 bbl., and motor-fuel production of natural-gasoline plants was 161 bbl.

Natural Gas

Cities Service Given Divorce Terms by SEC

PHILADELPHIA, Pa.—It has been recommended by the utilities division of the Securities and Exchange Commission that Cities Service Corp. confine itself to one of three systems, preferably the Mid-Continent gas system, if it proposes to continue in the utilities field. The company may elect to dispose of all of its utility interests and cease to be a holding company, in view of the company's extensive oil business, said Frank Field, SEC utilities division counsel. However, he said, if Cities Service remains as a holding company, the utilities division will require it to confine itself to the Mid-Continent gas system or such other utility system as it may elect as an alternative.

The utilities division also contends that Arkansas Natural Gas Corp., a holding subsidiary of Cities Service, must dispose of all its interests in the gas-utility business so that it cease to be a holding company, with the exception that it might retain its interest in Arkansas Louisiana Gas Co.

Expansion Planned for Edmonton Operations

EDMONTON, Alta.—Northwestern Utilities, Ltd., of Edmonton, has announced construction plans for 1943 which, if necessary materials can be secured, will involve an outlay approximating $360,000. The company will drill two additional wells in the Kinsella field, and is planning to enlarge the present 6⅝-in. line east of Kinsella station to 10¾-in. to handle the increased production.

Plans also include duplication of 12.8 miles of the main transmission line from the Viking-Kinsella field to Edmonton. Gas consumption is steadily increasing through servicing buildings used by the armed forces and an aggregate consumption of 950,000,000 cu. ft. for the current year is anticipated.

Southern United Seeks Authority to Operate

WASHINGTON, D. C.—Application of the Southern United Gas Co., Fort Smith, Ark., for permission to acquire and operate the properties of its six wholly owned subsidiaries will be presented before the Federal Power Commission here April 7.

The subsidiary companies, Twin City Pipe Line Co., Arkansas-Oklahoma Gas Co., Western Oklahoma Gas Co., Southwestern States Gas Co., Industrial Oil & Gas Co., and Ozark Natural Gas Co.

Southern United, a holding company owning all of the issued and outstanding stock of the six operating subsidiaries, now proposes to become an operating concern.

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REFINING

Phillips Given Contract on Kansas City Plant

WASHINGTON, D. C.—The War Department, according to Senator Truman, has given a contract to Phillips Petroleum Co. to operate a war-refinery unit under construction at the Phillips' Kansas City, Mo., refinery. Construction is said to have begun more than a month ago. The cost will be in the neighborhood of $3,000,000. The refinery will produce 100-octane gasoline at the rate of several thousand barrels a day.

Neches Butane Plant to Start Production Soon

PORT ARTHUR, Tex. — Herbert Henderson, Pittsburgh, Pa., chairman of Neches Butane Products Co., said here last week that the company's Port Neches, Tex., synthetic-rubber plant would start operation this summer, if delivery of critical materials continues without interruption.

Five major oil-refining companies in the Texas Gulf Coast district organized the Neches Butane company for manufacture of butadiene.

Mass Spectrometer Speeds Hydrocarbon Analysis

PHILADELPHIA, Pa.—The research organizations of the Atlantic Refining Co. at Philadelphia, and the Consolidated Engineering Corp. at Pasadena, Calif., have cooperated to bring to practical use for the first time in any industry the mass spectrometer, which will greatly expedite a critical part of the war program—the manufacture of aviation gasoline.

This development makes possible a marked improvement in the analysis of gases which are used in making high-octane aviation gasoline and synthetic-rubber stocks, and opens the door to unlimited research in these fields. In addition to improving present production methods, it is expected that the mass spectrometer may pave the way for entirely new gasolines.

As a consequence of their extensive activity in the war effort, Atlantic research scientists saw the many practical applications made possible by Consolidated Engineering Corp.'s development, and persuaded the latter company to built a mass spectrometer for use in aviation gasoline and other strategic programs.

The use of the mass spectrometer permits analysis of some gases that cannot be separated by distillation procedure. Such extension of the ability to determine hydrocarbons in gasoline may lead to the development of better, or even new gasolines.

To make tests and check tests, the past procedure required 1 cu. ft. of gas, 300,000 times as much as is needed by the mass spectrometer.

Because of its importance to war production the instrument is now being operated under a policy which limits disclosure of its results to those engaged in the national effort to manufacture greatly increased quantities of high-grade aviation fuels, and details of construction and operation are blanketed under secrecy orders.

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Sketches of Plant Operators

RICHARD K. ROWELL, recently appointed manager of the El Segundo, Calif., refinery of Standard Oil Co. of California, succeeding the late H. C. Hanna, began his oil career as a still cleaner in 1917 at Standard's Richmond refinery. After serving a few months, he entered World War 1, joining the 224th Aero Squadron of the U. S. Army in France. Mr. Rowell was mustered out early in 1919 and upon returning to his job at Richmond refinery was soon advanced to foreman of the filter plant. He advanced steadily through various supervisory positions in the manufacturing department.

In 1934, he was transferred to the El Segundo refinery as superintendent of pressure stills, retaining the title he had held for 6 years at Richmond. Later he was appointed refinery superintendent and in 1940 was advanced to assistant manager, continuing in the latter position until his recent promotion to fill the vacancy caused by the death of Mr. Hanna. Mr. Rowell, 49, has been associated with the California oil industry for almost 30 years, having spent 3 years with other Pacific Coast oil companies before coming to Standard Oil Co. in 1917.

All Bright Stocks May Be Placed Under Restriction

WASHINGTON, D. C.—An order restricting the use of all bright stocks suitable for aviation-engine service soon will be issued by the Petroleum Administration for War, it was reported here this week. All Pennsylvania bright stock and all Middle West and western production useable for avation-engine oil would be covered by the restrictive order. All refiners operating deasphalting and certain types of solvent processes would be required to produce a maximum amount of the heavy lubricating-oil stock.

One of the considerations delaying formal issuance of the order, it was understood, is the problem of providing immedate transportation to the points of consumption or adequate storage facilities at the refineries.

All lubricating stocks covered by the order would be purchased for military use probably through Defense Supplies Corp., for the Army, Navy and Lend-Lease.

Standard of Indiana Will Double Farmer Awards

CHICAGO, Ill.—To encourage increased farm production for war, twice as many farmers as last year will be awarded war bonds by Standard Oil Co. of Indiana during 1943 for outstanding agricultural accomplishments, it is announced.

Twenty-five-dollar war bonds will go to 155 farmers and 4-H club members in 14 central west states.

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PIPE LINES

Ickes Speaks of Third Texas-East Coast Line

WASHINGTON, D. C.—Petroleum Administrator Ickes said here last week that it is "quite within the realm of possibility" that a third big pipe line to the East may be found necessary.

Mr. Ickes made the statement in a letter to Rep. Snyder (D., Pa.), chairman of the Army appropriations subcommittee, in opposing the trans-Florida barge canal project from the viewpoint of the wartime situation.

Mr. Ickes said that pipe lines can be built in a relatively brief period of time, that they use materials and power with greater efficiency than any other carriers except ocean tankers.

"This time element, alone, I should think sufficient to decide the issue," Mr. Ickes said. "However, regardless of the time for construction, from a petroleum transportation standpoint the canal would be ruled out on the basis of efficiency in the use of materials and manpower, compared with the use of materials and manpower for pipe lines. Very careful calculations have indicated that barges and tugboats would use steel for the delivery of oil with only about 55 per cent of the efficiency of a large pipe line. . . ."

Mr. Ickes did not elaborate on his statement concerning the possibility of a third big pipe line in addition to the 24-in. line from Longview, Tex., now being extended to New York and Philadelphia and the proposed 20-in. line from the Houston-Beaumont area to Seymour, Ind., which will probably be extended to the East Coast.

Standard of Louisiana Expands Crude System

Standard Oil Co. of Louisiana is preparing to construct about 132 miles of crude-oil pipe line to move 15,000 bbl. daily from several fields to its refinery at Baton Rouge, La. The line will be built of 4, 6, 8 and 10-in. second-hand pipe.

Kanotex Considers Line To Great Lakes System

Kanotex Refining Co. has been considering plans for the construction of a refined products line which will connect the company's refinery at Arkansas City, Kans., with the Great Lakes Pipe Line Co.'s system. It is anticipated that the company will build and own the line itself.

CRC

PIPE LINE CONSTRUCTION EQUIPMENT

CRUTCHER-ROLFS-CUMMINGS
Pipe Line Equipment and Materials
Houston, Texas, U. S. A.

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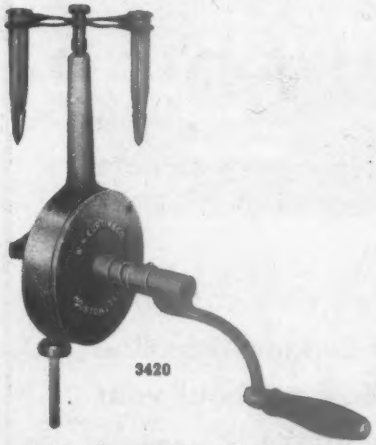

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Various Alloys
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Car Shortage Continues to Impede WEP Shipments

Because an insufficient number of tank cars has been furnished the Norris City, Ill., terminal of the 24-in. crude-oil line from Longview, Tex., the War Emergency Pipelines, Inc., system has not been able to ship eastward as much as the pipe line has been capable of transporting in the last 2 weeks.

The maximum number of tank cars available for loading at Norris City has been between 400 and 450 per day. An explanation of this shortage is being sought. During this period, 800 to 900 empty tank cars are being reported by the railroads as moving westward beyond Indianapolis, Ind. Railroad facilities and loading racks have ample capacity for shipping from Norris City. No empty cars have been held at the loading rack overnight. Water contamination which was troublesome when the line began to operate has been eliminated to a point where it is no longer objectionable.

Stormy weather has interfered with construction all along the line of the extension of the 24-in. pipe line.

Eleven survey parties are in the field along the route of the 20-in. products line from the Gulf Coast as far as Little Rock, Ark. Surveying is required beyond Little Rock at certain places where it is advisable to have the 20-in. products line right-of-way deviate for short distances from that of the 24-in. crude-oil line.

Deliveries of factory bends continue to be made along the route of the 24-in. extension eastward from Norris City. However, it is believed that factory bends will not be used in the laying of the 20-in. products line because construction men on the job have found that the large diameter pipe can be bent in a satisfactory manner by equipment in the field.

Oscar R. Burden, general superintendent, War Emergency Pipelines, Inc., is moving from the Little Rock, Ark., office to the main headquarters of the company at Cincinnati, Ohio.

Sinclair May Ship Products By Houston-Chicago Line

Sinclair Refining Co. has been giving consideration to converting part of its multiple-line system between Houston, Tex., and Chicago, Ill., to moving refined products according to a report which has not been confirmed. For a number of years, Sinclair has shipped natural gasoline mixed with crude; this transportation procedure has been employed extensively. It is reported that the company has dropped proposed plans for laying a line from Wood River, Ill., to Steubenville, Ohio.

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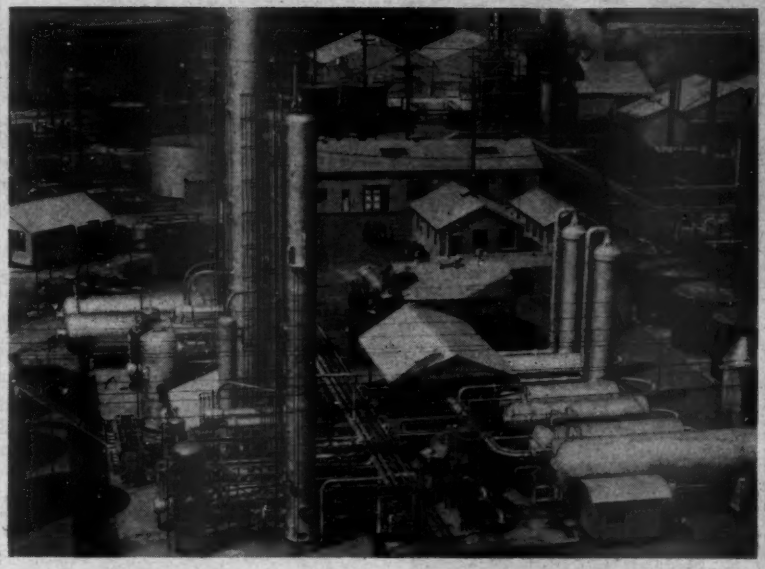

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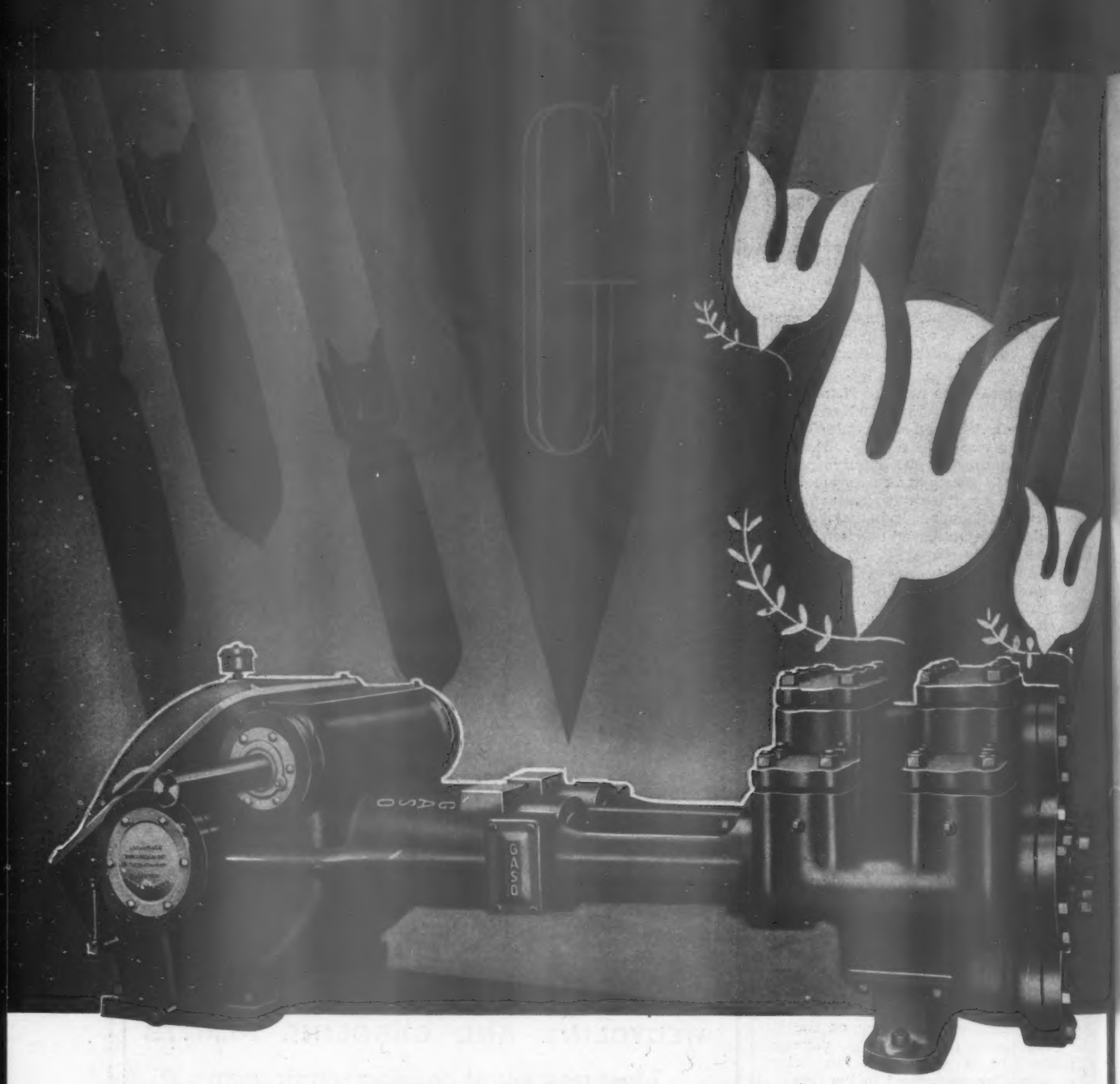

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Breakdowns in pumping equipment may under present conditions result in costly delays or even inability to replace the unit that fails. That's reason aplenty for instituting a special wartime program of conservation . . . The following suggestions are designed to help you in getting out of your Gaso Pumps all of the trouble-free service that has been built into them.

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2. Change lubricant in crank case at least twice a year. Use an SAE 90 EP Gear Lubricant in crank case, and an SAE 30 Motor Oil for roller bearings that have separate housings.
3. Adjust bearings at first sign of looseness.
4. Do not overload pump.

While our facilities are at war, our thoughts are still on peacetime customers; and we stand ready to do anything in our power to assist them in the job of conserving existing pumps until such a time as we are able to provide the new and even better models which will emerge from the expanded facilities and broadened experience of wartime service . . . Gaso Pump & Burner Mfg. Co., 902 E. First Street, Tulsa, Oklahoma. Export Office: 149 Broadway, New York. Los Angeles: Service Oil Field Supply Co., 5333 S. Riverside Drive.

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Exploration and Drilling

Week's Highlights

THE suggestion advanced on this page in the issue of February 25 that the Rocky Mountain area would bear watching this year is confirmed by reports this week of a discovery in the Wind River basin and of a new pay in the Oregon Basin field (p. 349).

Most of the oil produced in the Wind River basin has been black oil from the Tensleep and Embar formations, although there have been minor amounts of Cretaceous oil produced also. The deeper production from Maverick Springs in the north, Pilot Butte in the middle and Dallas-Derby in the south, without finding Sundance production, may make the latest discovery one of minor regional importance. On the other hand, the discovery of Sundance oil in the Wind River basin may indicate the possibility of more high-grade crude in this formation in basins to the south and west. The principal Sundance production at the present time is in the Powder River and Big Horn basins.

Discovery of oil in the Madison at Oregon Basin is also of considerable interest. Outside of Garland, this formation has provided little in the way of production in Wyoming, possibly because of inadequate testing. It is, however, the principal pay in Turner Valley in Canada and at Kevin-Sunburst in northern Montana so that the formation has possibilities all along the front of the mountains as well as in the Big Horn basin generally.

The Madison has long been thought of as a potential important producer throughout the whole of the northern Rocky Mountain area. It was the principal objective in deep tests on the Baker-Glendive anticline along the Montana-North Dakota border. Although some oil was found here, it did not prove commercial. The new discovery, extending this pay some 35 miles to the south and west of previously known production may encourage prospecting below the Tensleep and Embar throughout the whole area, when demand for more oil develops.

In spite of large production from pre-Pennsylvanian pays in other sections of the country, little has been done in exploring below the Tensleep in the Rocky Mountain area. The Tensleep and the overlying Embar lime were also not highly regarded because of the lack of demand for the black oil which they yield in many fields. Recently the demand for black oil has increased and the possibility of finding high-grade crude below the black-oil pays will probably stimulate even greater interest in the area than has been manifested to date.

MICHIGAN: An Osceola County wildcat 3 miles north of the Reed City field has reported a flow of 30 bbl. of oil an hour from the Monroe and a test in the Kawkawlin field of Bay County reported a flow of oil from the Traverse lime (p. 356).

SOUTHWEST TEXAS: A Nueces County wildcat east of Robstown has opened a new gas field from the Frio formation. Prior to completion, the well also flowed 18 bbl. of distillate daily. A gas-distillate discovery has also been reported 2½ miles south of Mineral, Bee County (p. 348).

OKLAHOMA: Gas production has been discovered in the Skinner sand in a Payne County wildcat and a test east of the Otoe City pool, Noble County, has been completed as an oil well (p. 346).

LOUISIANA GULF COAST: Two oil showings have been reported in the deep test 1 1/4 miles southeast of Egan, Acadia Parish (p. 351).

TEXAS GULF COAST: A new gas-distillate sand has been found in the Katy area of Waller County. The discovery well is about 2½ miles north of the Katy gas field (p. 352).

COMPLETIONS IN ALL FIELDS . . .

(Week Ended March 20, 1943)

	Oil	Gas	Dry	Total	Footage	Comb. to date 1943	Comb. to date 1942
N. Y., Pa., and W. Va.	41	11	4	56	108,528	632	809
Ohio	2	8	5	15	45,775	195	207
Indiana	3	0	2	5	10,944	56	77
Kentucky	0	2	0	2	4,136	43	56
Illinois	14	0	12	26	63,817	384	381
Michigan	3	0	5	8	21,592	83	141
Kansas	8	1	7	16	55,479	271	326
Nebraska	0	0	0	0	0	4	12
Missouri, Iowa	0	0	0	0	0	3	4
Oklahoma	8	3	9	20	52,599	231	337
Texas:							
North Central Texas	10	1	10	21	51,549	241	327
West Texas	9	1	3	13	65,439	174	435
Texas Panhandle	1	0	1	2	6,163	40	131
Eastern Texas	3	0	1	4	32,144	52	114
Texas Gulf Coast	4	1	2	7	50,587	81	199
Southwest Texas	6	0	6	12	63,305	176	303
Total Texas	33	3	23	59	269,187	764	1,509
North Louisiana	0	0	1	1	6,083	60	131
Louisiana Gulf Coast	6	0	5	11	89,592	75	132
Total Louisiana	6	0	6	12	95,675	135	263
Arkansas	3	0	1	4	17,853	47	33
Mississippi and Southeast	0	0	3	3	22,333	11	12
Montana	2	0	1	3	9,018	31	31
Wyoming	0	0	2	2	7,039	25	20
Colorado, Utah	0	0	1	1	2,821	2	4
New Mexico	3	0	1	4	9,781	44	60
California	16	0	6	22	74,229	211	208
Total United States	142	28	88	258	870,805	3,136	4,500
Total previous week	163	31	97	291			
Week ended March 21, 1942	160	26	104	290			

OKLAHOMA

Velma Pool Reports First Production in Hunton Lime

TWO wells, one an oil well and one a gas well, were reported out of a total of seven wildcats completed last week. In Payne County, F. N. Berry 1 fee, NW SE SE 26-19n-2e, opened a new gas area when it gaged 3,500,000 cu. ft. of gas in the Skinner sand at 4,057-62 ft. and in Noble County, east of the Otoe City pool, Superior Oil Co. 1 Gillham, NE SE SE 14-22n-1e, was reworked and completed for 10 bbl. of oil. New perforations at 2,562-90 ft. put oil in the hole and on swabbing tests it made 130 bbl. of oil and 180 bbl. of water. Source of the water was not given.

Stephens County.—The Velma pool, developed by Skelly Oil Co., has had a number of different pay zones in sands from 700 ft. to below 6,000 ft. but the first lime production was reported last week. Skelly's 1 Doak, SW NE SW 36-1s-5w, had total depth in Hunton lime at 4,882 ft. and swabbed at the rate of 30 bbl. of oil an hour with no water.

Oklahoma County.—West of the Edmond pool, Ace Gutowsky 1 Wagner, NW NW SW 32-14n-4w, shut down at 7,666 ft. in dry second Wilcox sand. Pipe was to be set to the Hunton, topped at 6,877 ft. A show of oil was found in the lime at 6,911-79 ft.

OKLAHOMA COMPLETIONS

Wildcats

Beckham County: Westoak Gasoline Co. 1 Brown, SE SE NW 36-10n-21w, dry, T.D. 4,660 ft.

Lincoln County: R. W. Willis 1 State, NW NW NW 36-12n-6e, dry, T.D. 4,635 ft., Misener 4,299 ft., Hunton 4,300 ft., Viola 4,505 ft., Wilcox 4,570 ft., second Wilcox 4,629 ft.

Noble County, E of Otoe City: Superior 1 Gillham, NE SE SE 14-22n-1e, pumped 10 bbl., T.D. 4,669 ft., perf. 2,562-90 ft., swabbed 130 bbl. oil and 180 bbl. water, recompletion.

Pawnee County: Johnson Oil & Ref. 1 Ward, SE NE 3-20n-7e, dry, T.D. 2,875 ft., sand 1,678 ft., Oswego 2,253 ft., Bartlesville 2,675 ft., Mayes 2,825 ft.

Payne County: F. N. Berry 1 fee, NW SE SE 26-19n-2e, gaged 3,500,000 cu. ft. gas, 1,620 lb. R.P., Skinner sand 4,057-62 ft., T.D. 4,728 ft., P.B. 4,160 ft.

Stephens County, NW of Loco: T. C. Vaughn 1 Hervy-Holloway, SE NE SE 31-2s-5w, dry, T.D. 1,754 ft., Arbuckle, 1,646 ft.

F. G. Clapp et al 1 Baker-McCasland, SW SW NE 8-1n-4w, dry, T.D. 2,501 ft., sand 1,305 ft. with show of oil.

(Field completions in next week's issue)

N. CENTRAL TEXAS

Young County Wildcat to Test Show in Caddo Lime

WICHITA FALLS, Tex.—Anderson-Prichard and Darby Petroleum Co. 1 Mooney, Mooney Survey, southern Young County, was plugging back from a total depth of 4,809 ft. to perforate casing opposite showing in the Caddo lime at 3,900-55 ft., for a test. Caddo was topped at 3,499 ft., and showings were recorded on electrical log from 3,499 to 3,570 ft., 3,770-80 ft. and 3,850 to 3,900 ft. Ellenburger was topped at 4,696 ft., with no shows. Hassie Hunt 1 Shields, Section 446, T.E.&L. Survey, 6 miles south of Jean, reported small shows of oil in Caddo lime from 3,754-63 ft. and was drilling ahead to 5,200 ft. before making a test.

Throckmorton County.—Bruce Sullivan is drilling his 1 Batchler estate, 5,000-ft. test located 660 ft. from south and east lines of Section 1691, T.E.&L. Survey. The test is west of the Daws pool and northwest of the Murray pool in western Young County.

Cooke County.—Development of the southeast extension area of the Walnut Bend pool will be rapid, with two new locations staked last week for the area. Sinclair Prairie Oil Co. stepped out ½ mile to the east for its 1 M. B. Harrison, 1,642 ft. from the north line and 330 ft. from the west line of Block 71, Fannin County School Land Survey, and Sun Oil Co. staked 2 Bacon, 330 ft. from the west line and 955 ft. from the south line of Block 70, same survey, for a southeast outpost. Same company's 1 Bacon reports more oil showings while drilling past 5,455 ft.

Jack County.—New try for further production in the Taubert & McKee pool was announced as Taubert & McKee and Sinclair Prairie 3 Boyd, 1,980 ft. from the east line and 660 ft. from the north line of Seth Hazel Survey, west offset to the Ellenburger discovery. The No. 2, south offset, was dry. Five miles northeast of this area, Youngblood & Foree are drilling below 4,240 ft. on their No. 1 Fulcher, Z. N. Morrell Survey. The south extension of the Hoefle pool received two new oil wells when Hanlon-Buchanan and Standard Oil Co. of Texas 1 Jackson flowed 73 bbl. in 8 hours from Caddo lime at 4,820-30 ft., and same operators' 1 Moore swabbed 20 bbl. per hour after treating Caddo lime at 4,788-97 ft. with acid.

NORTH TEXAS COMPLETIONS

Wildcats

Cooke County: Kingery Bros. 1 J. Fisher, SWC lot 18, J. Barnett Sur., A-42, dry, T.D. 1,652 ft.

(Field completions in next week's issue)

WEST CENTRAL TEXAS

ABILENE, Tex. — J. D. Hancock 1 Black Brothers, a wildcat in SW cor. Section 1144, T.E.&L. Survey, northern Stephens County, was drilling ahead after logging shows of oil in Caddo lime and in Marble Falls lime. Caddo was topped at 3,252 ft. and shows were drilled at 3,252-55 ft. and 3,263-67 ft. Shows in the Marble Falls lime occurred at 3,924-30 ft. At last report the test, projected to the Mississippi lime, had reached 3,940 ft.

Jones County.—This area continues to lead the activity in the West Central district, with two new wildcats getting under way last week. Northwest of the Avoca pool, Jones & Stasney and Groover & Rose started their 1 Youngquist, NW SW SW Section 189, B.B.B.&C. Ry. Survey, a Palo Pinto lime test ¾ mile northwest of production in the Avoca pool, and a mile southwest of nearest production in the North Avoca pool. The new test is surrounded by seven dry holes.

In South Jones, midway between the south edges of the Wimberly and Akard pools, Hedrick Oil 1 Arnwine is staked 330 ft. from north and east lines of 200-acre tract in the G. Martinez Survey 137, slated for 2,500 ft.

WEST CENTRAL TEXAS COMPLETIONS

Wildcats

Jones County: Fain & McGaha 1 B. Nevill, 2,190 ft. from S, 330 ft. from W tract, Sec. 260, T. W. Hunt Sur., Saddle Creek 2,340-42 ft., dry, T.D. 2,408 ft. shale.

Shackelford County: R. H. Roark 1 J. H. Todd, SE NW SW Sec. 11, Blind Asylum Lands, dry, T.D. 702 ft.

Stephens County: Cosden Pet. 1 S. E. Burgess, 467 ft. from N and E lines Sec. 4, Blk. 1, S.P.R.R. Sur., elev. 1,133 ft., dry, T.D. 4,250 ft.

(Field completions in next week's issue)

DAILY AVERAGE PRODUCTION FOR WEEK

	Mar. 20 crude oil	Mar. PAW quota all oils	Mar. 13 crude oil
Arkansas	70,800	78,700	70,800
California	780,500	823,700	779,500
Colorado	6,570	7,000	6,440
Eastern fields	93,000	115,000	89,000
Illinois	252,000	262,300	238,100
Indiana	15,000	16,500	16,000
Kansas	315,400	309,900	286,900
Louisiana	339,550	349,800	339,750
North Louisiana	*89,950*		*89,150*
Louisiana Gulf Coast	*250,600*		*250,600*
Michigan	55,700	63,700	61,100
Mississippi	58,300	50,000	53,850
Montana	19,690	23,400	17,680
Nebraska	1,900	2,800	2,400
New Mexico	105,600	105,800	105,610
Oklahoma	342,450	390,700	327,200
Texas	1,392,900	1,502,000	1,392,550
East Texas	*323,400*		*323,400*
West Texas	*218,100*		*218,000*
North Central Texas	*137,000*		*136,150*
East Central Texas	*99,800*		*99,800*
Texas Panhandle	*88,600*		*88,600*
Texas Gulf Coast	*458,350*		*458,950*
Southwest Texas	*67,650*		*67,650*
Wyoming	93,540	92,500	91,300
Total United States	3,942,900	4,193,800	3,878,180
Total production Jan. 1-Mar. 20, 1943			305,927,635 bbl.
Same period last year			317,458,120 bbl.

PERMIAN BASIN

Edge Well of Fullerton Pool Establishes Record Flow

MIDLAND, Tex.—Fullerton Oil Co. 4-A H. M. Wilson estate, south-edge well in the Fullerton pool of northwestern Andrews County, established a new record for the field when it flowed at the rate of 1,879 bbl. per day based on a 6-hour gage through 1-in. choke on 2-in. tubing set at 7,225 ft. Top of the pay was at 6,745 ft., and the well was drilled to a total depth of 7,255 ft. in lime and the pay section was treated with a total of 24,000 gal. of acid. In the same area, Texas Pacific Coal & Oil Co. 2 Emily Jackson, bottomed at 6,885 ft., was swabbing after initial acid treatment of 2,000 gal. On the northeast edge of the pool, Fullerton 2 McKean & Eilers, NE SW Section 14, Block A-32, Public School Lands, was drilling below 6,165 ft. in lime.

Sutton County.—The southern part of the Permian basin was favored with a wildcat location to be M. C. Moore 1 C. D. Wyatt, NW NW Section 7, Block 6, T.W.N.G. Ry. Survey, 10 miles southeast of the gas discovery from the Pennsylvanian brought in late last year by Moore and S. B. Roberts at their 1 Allison. Contract depth on the new test is 4,500 ft., or 100 ft. into the Ellenburger.

After abandoning at 8,486 ft. the 1 Clark in Sterling County, Ohio Oil Co. moved 1½ miles southeast where it will drill 1-B Clark in NW NW Section 82, Block 5, H.&T.C. Ry Co. Survey, Tom Green County, to 3,300 ft. In northwestern Sterling, Col-Tex Refining Co. had drilled to 9,060 ft. in black shale.

Martin County.—The center of the Permian basin received a wildcat location last week when J. D. Bodkins staked his 1 Scharbauer Cattle Co., SE SW 27-39-1n, T.&P. Ry. Sur., 20 miles west of Stanton. Nearest test was drilled 5 miles east, being Wiggins & Hyde 1 Stimpson, Section 4-38-1s, dry at 5,002 ft.

Pecos County. — Bryce McCandless 1 University, Section 20, Block 26, University Survey, a 6,000-ft. test, topped Yates at 680 ft. with a good show of oil from 690-710 ft. and was drilling at about 1,860 ft. in lime. Phillips Petroleum Co. 1 Ada Price, 27 miles southeast of Fort Stockton, had drilled to 9,840 ft. in shale, no change. Magnolia 1-29 Eaton, southwest of the Abell pool, topped McKee sand at 7,169 ft., the Waddell at 7,659 ft., and cored to 7,705 ft., no shows reported.

Winkler County.—Magnolia 20 State Walton, Ordovician test on the east side of the Kermit pool, tried drill-stem test at a total depth of 9,970 ft. with packer set at 9,950 ft., but it failed, and another attempt was to be made. Unconfirmed reports say that Amon Carter C-2 Walton is drilling around 9,500 ft., with Simpson topped at 9,460 ft.

Yoakum County. — Barnsdall Oil 1 Heath, Section 315, Block D, J. H. Gibson Survey, was drilling below 7,400 ft. in hard dolomite, and in the southwest part of the county, Humble 1 Tannehill, SW NE Section 840, Block D, was drilling below 4,400 ft. in anhydrite.

WEST TEXAS COMPLETIONS

Wildcats

Pecos County: Gulf Oil Corp. 1 Rooney Mercantile Co., NW NW Sec. 82, Blk. OW, C.C.S.D.&R.G.N.G. Sur., elev. 2,996 ft., dry, T.D. 423 ft.

Sterling County: Ohio Oil 1 L. T. Clark & Sons, NE SE Sec. 6, Blk. A, R. R. Wade Sur., elev. 2,249 ft., Ellenburger 7,705 ft., dry, T.D. 8,486 ft.

(Field completions in next week's issue)

SOUTHEAST NEW MEXICO

HOBBS, N. M. — R. Olsen and Atlantic 1 Langlie, SE SE 11-25s-37e, southeastern Lea County, was deepening after taking a core from 9,490 to 9,506 ft., recovering 3 ft. of dolomite with no shows. Stanolind Oil & Gas Co. 1 J. W. Fuller, 25-8n-30e, Quay County, was coring below 6,739 ft. Some shows of oil have been reported above 2,500 ft., but nothing below that depth.

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SOUTHWEST TEXAS

Nueces Wildcat Flows Gas From Frio Formation

CORPUS CHRISTI, Tex. — Phillips Petroleum Co. has a producer in its wildcat, 1 William Huermann, 5½ miles east of Robstown, in the Charles Land Survey 412, Nueces County. The well gaged 30,000,000 cu. ft. of gas, open flow, on a State Railroad Commission test. On a previous test the Huermann well made 18 bbl. of distillate a day through ⅛-in. choke, with tubing pressure 2,625 lb., casing pressure 2,750 lb., and gas-oil ratio 35,000. Perforations are at 7,202-08 ft. in the Frio formation. The pay sand is at 7,202-21 ft., total depth 8,176 ft. This discovery is 10 miles west of Corpus Christi on a block containing 1,530 acres owned by Phillips. The nearest production is about 2 miles to the east, in the Saxet field. Violet field is the name given to the newly discovered pool by the South Texas Geoolgical Society.

Bee County. — Recording a second discovery for the lower Gulf Coast area, Dirks Brothers brought in their 2 C. S. Page estate, 2½ miles south of Mineral, in the Thomas K. Pilkington Survey, for a producer initially making 124 bbl. of distillate and 3,065,000 cu. ft. of gas daily, through ¼-in. choke. Tubing pressure was 2,000 lb., shut-in pressure 2,150 lb., and gas-oil ratio 23,000. Total depth is 7,982 ft., plugged back to 7,480 ft. Perforations are at 7,850-75 ft. It had been intended originally to carry the hole to 7,800 ft. but holders of offset leases made contributions to deepen. Mineral field is the name chosen by South Texas Geological Society.

Karnes County.—Seaboard Oil Co., which recently opened the new Hobson field with its 1 Julia Rzeppa, is below 4,000 ft. on a west offset, 1 R. F. Fertach, and is reported to have picked up 15 ft. of oil sand, in contrast with 7 ft. found in the discovery. With perforations at 4,016-32 ft. the well flowed in 15 minutes, with 95 lb. pressure, on a drill-stem test.

Victoria County. — Continental Oil Co. has started deepening its 1 K. L. Welder, 7½ miles southeast of Nursery, S. A. Belding Survey. This wildcat was drilled to 6,525 ft. and abandoned as dry in March 1942. It is planned to carry the hole to 9,500 ft.

Jim Wells County.—It had been expected that something conclusive would be found in the past week in Sam E. Wilson, Jr., and D. Auld 1-A Maria S. de Garza, which is at 8,211 ft., plugged back to 7,366 ft., but the testing tool was lost in the hole and a fishing job was under way. This wildcat, 2¾ miles east La Gloria, produced encouraging shows at higher levels.

Starr County.—The T. E. Stephens 1 Gonzales heirs, 10 miles north of Roma, was rerunning tubing in the course of efforts to complete this wildcat, which is reported to have found pay. Mr. Stephens has about 4,000 acres under lease in the district. In the South Texas area Kirby Drilling Co. is rigging up for a wildcat test, 1 M. Elizondo, 5 miles southwest of Robberson.

Wildcat operations.—New work in the South Central Texas area includes J. L. Sessions 1 William Maltke, Guadalupe County; Marts & Beaven, Inc. 1 W. S. Red, 1½ miles southwest of Elroy, Travis County, and John A. Deering Co. 1 F. J. Adams, 2 miles southwest of Lockhart, Caldwell County.

LOWER GULF COAST COMPLETIONS

Wildcats

Bee County: Dirks Bros. 2 C. S. Page estate, Thomas K. Pilkington Sur., 123 bbl. distillate and 3,065,000 cu. ft. gas through ¼-in. choke, T.P. 2,000 lb., S.I. C.P. 2,150 lb., gas-oil ratio 2,300, perf. 7,850-75 ft., T.D. 7,982 ft., P.B. 7,480 ft., discovery.

Victoria County: Rowan & Hope 1 H. W. Dodd, 6 miles S of Inez, dry at 6,010 ft.

SOUTH CENTRAL TEXAS COMPLETIONS

Kerr County: Continental 1 G. F. Schreiner, dry at 6,010 ft.

SOUTH TEXAS COMPLETIONS

Live Oak County: Sal Viejo Oil Co. 3 J. S. Riser, A. Moore Sur., dry at 2,848 ft.

Starr County: Continental 2 Dee Davenport et al, 2 mi. E of Rincon field, dry at 6,000 ft.

(Field completions in next week's issue)

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ROCKY MOUNTAIN

Oil Discovery Reported In Fremont County

DENVER, Colo.—The Rocky Mountain area scored twice this week with a prime discovery on the Steamboat Butte high in Fremont County and a discovery in a deeper horizon in the Oregon Basin field, both in Wyoming. The wildcat discovery was made in the British - American Oil Producing Co. 1-E Tribal, NE NW NW 5-3n-1w, 3 miles to the northwest of the nearest Tensleep producer in the Pilot Butte field. It had the top of the Sundance sand at 5,079 ft. and stopped drilling at 5,094 ft. to make a drill-stem test. On this test, with valve open 1 hour, the fuid rose 2,800 ft. in the hole, the upper part showing around 30 gravity oil and the lower part cut with drilling mud. The oil is brown in color and apparently free from any sulfur content. When cleaned up, the quality of the oil is expected to show considerable improvement. Casing is being run and well may be completed at this depth or drilled a little deeper into the sand. It is showing considerable gas pressure and indications point to a good body of sand below present total depth. Observers estimate that the well may be good for around 1,000 bbl. as it stands.

In the spring of 1942 the Superior Oil Co., jointly with British - American, made a discovery in the Tensleep in their 1 Tribal, SW SE SW 15-3n-1w, in the old Pilot Butte field, the well making 750 bbl. daily on a 2-day pumping test from 6,446 ft., total depth, it being a black oil testing 24.7 gravity. Subsequent drilling out in several directions from the discovery showed considerable nonconformity with evidence of subsurface faulting. Several years ago the Kinney-Coastal Oil Co. did considerable exploratory work, opening two gas wells in the Muddy sand. J. A. Warren, now president of that company, on the basis of subsurface geology worked out from well logs, suspected the existence of a high to the northwest and so mapped it. Subsequently, the presence of this high was confirmed by geophysical surveys and last December British-American spudded in the Steamboat Butte wildcat with results noted above. The well showed favorable indications almost from the start, picking up some gas in Frontier, a show of oil in the Muddy and saturation in the Dakota, topped at 4,167 ft. A drill-stem test on the latter showed 370 ft. of oil and 30 ft. of Muddy water in 1 hour. Drilling then continued with the Tensleep as one of the objectives when Sundance oil was found.

The Oregon Basin discovery took place in the Yale Petroleum Corp. 4 Hancock NW NE NE 5-50n-100w. This is a black-oil field which is producing from the Embar-Tensleep. It has large reserves in those horizons and the field, which consists of two highs with an unexplored saddle in between is approximately 9 miles long and 3 miles wide. The Yale Petroleum well is located near the top of the south dome and south of a major fault traversing structure from northeast to southwest. Three or four good producers have been drilled south of this fault in the present campaign started about 2 years ago, all stopping after going into the Tensleep. The 4 Hancock well was carried down to test the Madison lime and was drilled to 4,663 ft. The top of the Madison was at 3,920 ft. and first saturation was picked up at 4,018 ft. Casing was run and was gun-perforated at intervals above 4,000 ft. Swabbing through the tubing for a test then was started. Results have not yet been announced, but point to it being a substantial producer in the Madison. If it is completed in that horizon it may result in a more extended development campaign, but it is possible that the new pay will be plugged off and the crude kept in the ground for future reserves. The well is on a 161-acre tract leased from the Government for which a bonus of $175 an acre was bid by Yale at a sale in January, 1942.

(Field completions in next week's issue)

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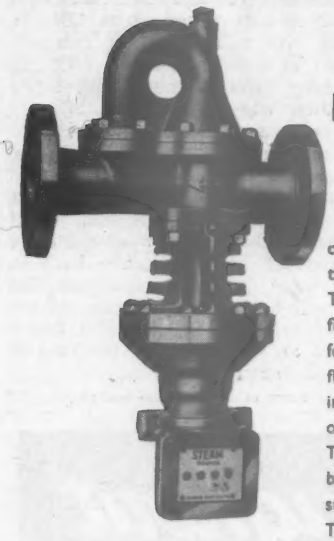

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EASTERN TEXAS

Deep Test Located In Kaufman County

DALLAS, Tex. — Four widely scattered wildcat locations featured the development in East Texas. Deepest of these will be Sun Oil Co. 1 J. M. Rutledge, in northeastern Kaufman County, 7 miles northeast of Terrell, 660 ft. from the northeast line and 2,376 ft. from the southeast line of a 200-acre tract in E. Parsons Survey. It is scheduled to go to 10,000 ft., testing the Smackover lime section along the east flank of the Balcones fault zone which runs in a northeast-southwest trend through Kaufman County.

Morris County.—Humble has staked location for a deep test on its block lying 2 miles southwest of Omaha, 660 ft. from the north and west lines of H. N. Wright 84-acre tract in the Samuel Story Survey. It is believed the test will go sufficiently deep to test the entire Trinity series, through the Travis Peak formation.

Upshur County. — A Woodbine test was staked 3 miles east of Big Sandy, to be known as H. H. Groneman 1 W. H. Johnson, 330 ft. from the south and west lines of a 72-acre tract in the William Williams Survey. Contract depth is 4,000 ft.

Henderson County.—A wildcat, the Stanolind Oil & Gas Co. 1-B Tri-Cities unit, 6 miles southwest of Athens, recovered stuck drill pipe and is coring below 7,864 ft. Cores above this depth showed faint gas odor and light stains of oil. Its 1-D Tri-Cities unit, 2 miles farther southwest, is fishing at 7,324 ft. Glen Rose was topped at 6,270 ft.

Hunt County. — Stanolind 1 Tilson heirs, 2 miles northwest of Campbell, was drilling below 3,207 ft. in chalk. Pecan Gap was topped at 1,880 ft. and elevation is 625 ft.

Rains County.—East of Emory, the American Liberty Oil Co. 1 Republic Insurance Co. was drilling below 3,183 ft., elevation 483 ft.

Robertson County.—Fitzwater et al 1 Stegall, 2½ miles west of Franklin, was shut down after running electric survey to total depth of 3,400 ft.

Smith County.—Wycliffe 1 O. Hackett was drilling again at 5,850 ft. after recovery tools lost in the hole.

Wood County. — Bobby Manziel 1 Bailey, Burch Survey, 5 miles southeast of the Coke pool, was drilling below 6,190 ft., probably in Georgetown lime. Amerada 1 Turner, Smackover lime test on east side of Coke pool, was drilling at 5,780 ft. Same company's 1 Blalock, west side of the Quitman pool, was drilling into the pay below 6,311 ft., running structurally next to the highest well in the field. Shell Oil 2 Goldsmith registered a comparatively low potential when it was completed for 276 bbl. per day last week.

(Field completions in next week's issue)

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LOUISIANA GULF

Oil Showings Reported in Acadia Parish Deep Test

NEW ORLEANS, La.—Two oil shows are reported to have been found in Sun Oil Co. 1 J. R. Daily et al, 1¼ miles southeast of Egan, in Acadia Parish. At the week end the well was drilling below 11,505 ft. Standard Oil Co. of Ohio was associated with Sun in drilling this wildcat, but when the hole reached contract depth it was taken over by Sun for deeper drilling. At 10,503 ft. an electric survey was made.

Beauregard Parish. — No show was reported at General Crude Oil Co. 1 C. S. Baldwin, in the Bear area when an electric log was run at 9,010 ft. It was said the hole would be carried to 9,500 ft. and another survey taken.

Acadia Parish.—Union Sulphur Co. 1 J. P. Gueno, 51-8s-2e, which lost a long string of drill pipe when the well blew out and caught fire last fall, sidetracked at 10,121 ft. and drilled on junk to 10,253 ft. in the first sidetracked hole. It was preparing to plug back and sidetrack.

St. Charles Parish. — Gulf Refining Co. was trying to reestablish production in the Bayou Couba field, where it is drilling its third test in that area, 5 Delta Securities Co., 7-15s-22e. The well was at 8,440 ft. at the close of the week and 5½-in. casing was cemented at that depth. Gulf 1 Delta Securities, which opened the pool last year, went dead after making 2,880 bbl. of oil and was abandoned recently after a workover job failed to restore production. No. 2, north of the discovery, was a failure.

Cameron Parish. — Stanolind Oil & Gas Co. effected a dual completion of its 65 State-Black Lake, in the West Hackberry field, getting initial production of 660 bbl. from perforations at 9,636-9,754 ft. through 1½-in. choke and 456 bbl. from perforations at 9,234-48 ft. through ⅞-in. choke.

St. Landry Parish. — Sun's closely watched wildcat, the 1 A. T. Burleigh, 37-7s-6e, confirmed favorable forecasts and was completed with initial production of 146 bbl. of oil, along with 270,000 cu. ft. of gas through ⅛-in. choke. Shuteston is the name given to the field opened by the Sun discovery.

LOUISIANA GULF COAST COMPLETIONS

Wildcats

Beauregard Parish: American Republics Corp 1-X Lutcher Moore Lumber Co., 3-6s-13w, dry at 12,455 ft.

Rapids Parish: J. P. Perry 1 Perry & McGinty, 3-4n-3e, dry at 5,660 ft.

St. Landry Parish: Sun 1 A. T. Burleigh, 37-7s-4e, 146 bbl. oil and 270,000 cu. ft. gas through ⅛-in. choke, T.P. 1,600 lb., C.P. 1,500 lb., gas-oil ratio 1,849, perf. 9,495-9,505 ft., T.D. 11,505 ft., P.B. 9,578 ft., discovery, field named Shuteston.

(Field completions in next week's issue)

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TEXAS GULF COAST

New Gas-Distillate Sand Opened in Katy Area

HOUSTON, Tex.—A new sand for the Katy area has been established by Stanolind Oil & Gas Co. 1 G. T. Pattison, in the J. M. Bennett Survey, Waller County, Texas. At total depth of 8,000 ft. and with perforations at 6,848-51 ft. this wildcat is reported to have flowed at the rate of 99 bbl. of distillate and 3,660,000 cu. ft. of gas in 24 hours through ½-in. choke. Tubing pressure was 1,800 lb., casing pressure 2,400 lb., and gas-oil ratio 37,000. A squeeze job was done, preparatory to perforating at 6,629-33 ft. In earlier tests the well, which is 3½ miles north of the Katy gas field, flowed gas at 7,338-45 ft. and at 7,116-21 ft. It showed gas on a drill-stem test at 6,520 ft. while drilling.

Liberty County. — General Crude Oil Co. 3-B Welch fee is reported to have established production on the southwest flank of the Esperson dome, Duncan Survey, flowing about 650 bbl. of oil through ¼-in choke from perforations at 8,400-30 ft. Tubing and casing pressures were each 1,350 lb. Total depth was 9,518 ft. The Welch fee is 1⅛ miles southwest of the nearest production.

Colorado County.—Magnolia Petroleum Co. 1 Anderson Bros., 1½ miles southwest of Chesterville, was at 5,787 ft. in shale. It topped the Marginulina Cocoensis at 4,780 ft., Massilina Pratti at 4,910 ft., Textularia Hockleyensis at 5,029 ft.

Galveston County. — Maco Stewart will try to complete his 1 Stewart fee, which it had been expected would be plugged and abandoned. This wildcat, in the James Spillman Survey, east of the Hitchcock field, was drilled originally by Glenn H. McCarthy to 7,780 ft., where it encountered heaving shale. At 5,223 ft. 10¾-in. casing had been set for protection. Mr. Stewart has obtained permission from the Railroad Commission to complete the well in the shallow Miocene.

Jackson County. — Humble Oil & Refining Co. 1 A. C. Isaacson, 3½ miles southeast of El Toro, was at 6,760 ft. in shale and waiting on orders, with no shows at that depth.

Matagorda County.—Superior Oil Co. 1 F. B. Peterson, 3 miles northeast of Van Vleck was wrestling with stuck drill pipe. The hole was at 10,702 ft. when the drill pipe stuck 4,590 ft. off bottom. It was cut at 5,196 ft. and pulled.

Continental Oil Co. has staked location for 1 S. G. Anderson, a wildcat test, 3 miles east of Collegeport, Matagorda County. Projected depth is 6,000 ft.

(Field completions in next week's issue)

ILLINOIS

Saturated Sand Recovered In Franklin County Well

MATTOON, Ill.—The Seaboard Oil Co. has set casing at 3,098 ft. for a test of saturation in the Aux Vases sand at 3,116-26 ft. in the 9 U. S. Coal & Coke, NE NE NE 26-6s-4e. The well is still in saturated sand at a total depth of 3,126 ft. A core cut from 3,118-26 ft. showed fine, porous, well-saturated sand. Meanwhile, the 8 U. S. Coal & Coke, discovery well of production in the area, is being put on pump for a production test of the Aux Vases sand at 3,122-28 ft. and is showing for about 300 bbl. of oil a day on the pump. A new location in the area is the Seaboard Oil Co. 10 U. S. Coal & Coke, to be drilled in the NE SE SE 23-6s-4e. This new producing area is a few miles north of Thompsonville in Franklin County.

The Nash Redwine 1 Prudential Life Insurance Co., SE SW 27-3s-3e, Jefferson County, is drilling ahead below 3,650 ft. for the Devonian lime expected at about 4,300 ft. A core was cut in the Warsaw lime last week at 3,622 ft. but no signs of saturation showed up in the core.

The Northern Ordnance Co. has completed arrangements to drill two Devonian tests in the north part of the Illinois basin. The first to be drilled is the 1 M. O'Connor, NW NE 28-9n-1e, about 12 miles north of Vandalia. The second deep test will be drilled in Clay County, SW SE 5-2n-5e, 1½ miles west of Xenia. Both of the deep tests are to be drilled on acreage formerly held by the Carter Oil Co.

ILLINOIS COMPLETIONS

Wildcats

Clay County: F. Jablonski 1 A. Burge, SW SW SW 11-5n-5e, dry at 2,384 ft.

Cumberland County: Papoose 1 Currey, NW NW NW 3-10n-7e, drey at 2,246 ft., Aux Vases 2,131 ft., Fredonia 2,163 ft., McClosky 2,170 ft., St. Louis 2,240 ft.

Franklin County: Adkins 4-D Orient, NE NE SE 13-7s-2e, dry at 2,654 ft., Tar Springs sand 2,061 ft., cut fault in Tar Springs, junked hole.

Jefferson County: Byers & Ellison 2 Jeff O. & G., NE SE NE 31-3s-2e, dry at 2,769 ft., Fredonia 2,680 ft.

St. Clair County: T. A. Curn et al 1 Yoch, NE NE SW 8-1n-10w, dry at 85 ft.

Wabash County: C. E. Skiles 1 Shaw, NW NW NW 27-1n-13w, dry at 2,798 ft., Menard 1,867 ft., Waltersburg sand 1,937 ft., Tar Springs 1,900 ft., Glen Dean 2,096 ft., Hardinsburg 2,139 ft., Golconda 2,231 ft., Cypress sand 2,347 ft., Benoist 2,523 ft., Ste. Genevieve 2,639 ft., McClosky 2,683 ft.

Wayne County: Deep Rock 1 J. Anderson, SW NW 35-2s-5e, dry at 3,354 ft., Fredonia 3,288 ft., McClosky 3,335 ft.

White County: First National Pet. Trust 1 M. Schieber, SW SE SE 6-6s-11e, dry at 3,056 ft., Kincaid 1,783 ft., Palestine 2,005 ft., Tar Springs sand 2,270 ft., Glen Dean 2,364 ft., Hardinsburg sand 2,441 ft., Golconda 2,485 ft., Cypress sand 2,639 ft., Benoist sand 2,779 ft., Aux Vases sand 2,880 ft., Ste. Genevieve 2,909 ft., St. Louis 3,042 ft.

(Field completions in next week's issue)

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CALIFORNIA

Wildcat Exploration Fails To Fulfill Expectations

LOS ANGELES, Calif. — Development work in proved fields appears to be running slightly above last year, but wildcat exploration has not come up to expectations. The present position of drilling operations in existing fields reflects aggressive drilling by Standard Oil Co. of California, Shell Oil Co., Inc., and a few other operators, but there has been no general increase by smaller independent concerns and none can be expected as long as present depressed prices for crude oil continue. Well-financed operators are able to proceed with additional drilling but the smaller operator who must meet the cost of new drilling out of current revenues is unable to undertake even remedial work. This is especially true of fields in the San Joaquin Valley but also prevails in other localities as well.

Several wildcat prospects were abandoned last week, the outstanding of which was Shell's Posuncula wildcat on Kern County Land east of Canfield Ranch in Kern County. This wildcat was abandoned when the Stevens sand of Miocene age was found barren at 8,370 ft. Canfield Ranch field has always been of outstanding interest because it is one of the few fields in California that are one-well fields. Di Giorgio Fruit Co.'s wildcat in the Mountain View district of Kern was another wildcat that failed to find the farmer's sand and has been abandoned as a duster. Paul Getty's San Fernando prospect was another that failed to show production and has been abandoned. This wildcat ran into a fault. Formation was found standing vertical at 3,559 ft. In the meantime, Ramsey Petroleum Corp. is preparing to drill on the north side of Chatsworth reservoir several miles away from Getty's abandoned hole.

Kern County: Recent developments in the South Belridge field of Kern County indicate the probability that the outer limits of production in this field will be greatly enlarged during the next several months. Last year E. A. Parkford drilled and completed a good well almost ½ mile from production in the southeastern end of the field and since that time the limits of production have been extended in other areas as well. Recently, Texas Co. drilled two good wells on the Wrightson property another ½ mile from production, and the trend at present is to the east and north of Parkford's property. These wells are commercially productive because the pay is found around 1,000 ft. and therefore drilling costs are comparatively low. This crude is of a heavy grade much in demand at present for fuel oil which is at peak demand. These shallow wells are drilled for the most part by portable drilling equipment of a conventional type and actual drilling time is only a few days.

LOS ANGELES BASIN

Orange County.—Shell Oil Co., Inc., 56-16 Olinda fee 4 in the Yorba Linda field of Orange County began flowing 400 bbl. per day of clean 19.6-gravity oil. This well was originally completed several weeks ago as a relatively small pumping well and without warning began flowing through the pump. Current production is 375 bbl. per day through a 1-in. bean. Tubing pressure is 85 lb. and casing pressure 400 lb. Current completions in the Yorba Linda field have, with few exceptions, proved to be good wells considering the shallow depth at which production is secured and the resulting low drilling costs. This field was discovered several years ago when a core hole began flowing but has been shut in until last year. Upon finding commercial production in the core hole, which was drilled as a survey hole, Shell completed a contract with Olinda Land Co. whereby the former purchased the fee holdings of the latter for approximately $500,000. The contract provided that Shell would buy the property for the stipulated sum but that Shell would be allowed to drill and test the property before

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PATTERSON-BALLAGH CORPORATION
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PIPE & TUBING WIPERS

completing the transaction. When the demand increased for heavy crude oil to meet current requirements for fuel oil, Shell resumed drilling at Yorba Linda and has completed 10 good wells to date.

Signal Oil & Gas Co. is drilling a wildcat on the Irvine ranch in the Corona Del Mar region and should be able to determine the production possibilities of the area soon as this area will not require deep drilling. Miocene outcrops indicate the critical depth should be reached at about 2,500 ft.

Huntington Beach in Orange County is becoming active again due to operations of Signal Oil & Gas Co. on its Bolsa lease, Standard on its Huntington A lease and Southwest Exploration Co. which is developing its tideland lease. Signal has made seven locations and Standard Oil Co. has one new derrick and six additional locations. At Montebello, Kern Oil Co. is completing 45 Monterey in the upper sand at 3,297 ft. and it looks good for about 100 bbl. per day. Standard's next completion at Montebello will probably be 107 Baldwin which is showing more gas than other recent completions. Long Beach Oil Development Co. is about the only operator doing any work in the Wilmington field although there are a number of reconditioning jobs under way. Most of this work consists of cleaning out or redrilling the lower part of the hole and gravel packing.

COASTAL DISTRICT

Ventura County. — Continental Oil Co. is having considerable trouble with 2 Holser on the Jacknife Ramona anticline, but may have it pumping within the next several days. This field contains an unusual thickness of oil sand, but it appears to be dead in the reservoir and contains insufficient natural gas to flow.

On the Hidden anticline in Ventura County, Tide Water Associated Oil Co. is drilling ahead at 5,110 ft. but has not yet encountered the pay.

Honolulu Oil Corp. has started the first new well to be started in the Rincon in a long time and is making good progress. This new well is located on Permit 56 which has been productive for several years. North of the Rincon fault, Shell Oil Co., Inc., is testing its Tomson lease and will determine the possibility of extending the productive limits of the field.

Santa Barbara County. — In the Santa Maria Valley field Union Oil Co. is preparing to drill four additional wells on the Union Sugar, Battles and Vicente leases. Union recently secured approval of plans calling for the erection of a new natural-gasoline plant which will more adequately treat the wet gas and recover the maximum amount of isobutane.

(Field completions in next week's issue)

KANSAS

Vaughn Extension Connects Three Producing Areas

ONE wildcat completed as an oil well and a number with favorable showings were reported as the week ended. In Barton County, the Texas Co. 1 Lantermann, SW SW 27-19-11w, pumped 52 bbl. of oil a day in Ar. buckle lime at 3,333-61 ft. It is an extension on the north side of Silica and about midway between the Lantermann and North Ellinwood pools.

Russell County.—Alva Billings et al 1 J. A. Krug, NE NE SW 8-14-14w, had 1,200 ft. of oil in the hole in 6 hours in Lansing lime at 3,074-81 ft. The well, reported as an extension to the Vaughn pool, is 1 mile north of that field and approximately the same distance southeast of the Gorham pool. Edge wells of the Hall-Gurney field are about 1½ miles to the southeast so that the well actually is a connecting link for this one large producing area.

Pratt County.—Skelly Oil Co. 2-B Knop, SW SE SE 25-26-13w, east offset well in the north Iuka pool, swabbed 187 bbl. of oil in 6 hours after a 750-gal. acid treatment in

(Continued on Page 357)

POWER TO SPARE

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OHIO, KENTUCKY

Large Gas Wells Completed In Clayton Field

ZANESVILLE, Ohio—The Clayton pool in Perry County had two fair completions this week on inside locations, and two fair gas wells were finished in the Sandyville gas field. The Ohio Oil Co. is drilling at 3,000 ft. on the deep wildcat on the Fitzgerald tract in Section 2, Center Township, Guernsey County. Sinclair Prairie are shut down for repairs at 6,830 ft. on the wildcat in Olive Township, Meigs County. Brendel Oil & Gas Co. is drilling at 3,900 ft. on the wildcat on the Warren tract in Section 24, Malta Township, Morgan County.

(Field completions in next week's issue)

EASTERN KENTUCKY

ASHLAND, Ky.—The drilling operations in this part of Kentucky slumped slightly this week although three new locations were reported and road-building activities have been pushed quite rapidly.

The completion of a good producer in Berea sand in Knott County where a number of excellent Weir wells have been completed is said to emphasize the good production possibities in the region.

EASTERN KENTUCKY COMPLETIONS

Pike County: Kentucky West Virginia Gas Co. 704 P. B. Stratton et al, at the head of Red Creek near Millard, T.D. 2,938 ft. in Berea, 1,639,000 cu. ft. of gas.

Knott County: Kentucky West Virginia Gas Co. 5431 Wilson King, Right Beaver Creek, T.D. 2,884 ft. in shale, 174,000 cu. ft. of gas.

NORTH LOUISIANA

Bossier Parish Wildcat Finds Pettit Lime Dry

SHREVEPORT, La.—Hunt Oil Co. 1-A Pardee, NW NE 18-23n-11w, Bossier Parish, was reported dry last week at total depth of 6,083 ft. Formation tops were lacking but perforations and an acid treatment to test a show of oil at 5,942-63 ft. recovered only salt water. Considerable interest was shown in this wildcat and it was hoped that it would be an extension to the North Carterville Pettit lime pool, about 3 miles northwest of it. This was the only completion reported for North Louisiana.

Four field completions and one wildcat reworked indicated an upturn in operations for Arkansas. The Haynesville pool on the Arkansas State line got another large producer at Navarro Oil 3 Beene in Section 3-20s-20w. The well flowed 528 bbl. of oil from Pettit lime at 5,412-30 ft.

In Miller County, Barnsdall's Grace, Section 4-15s-27w, had saturated cores from 6,181-6,505 ft.

MISSISSIPPI

JACKSON, Miss.—Pure Oil Co. 1 J. M. McDowell, 1-6n-4w, Adams County, was reperforating at 10,252-68 ft. and operators planned to make a drillstem test. Washing the well and swabbing to 8,600 ft. had produced no results.

Humble Oil & Refining Co. 1-B L. N. Dantzler Lumber Co., 20-5s-8w, Jackson County, was reaming at 500 ft. after the drill stem, stuck at 1,540 ft. had been cut and pulled.

The California Co. 1 G. T. Smith, 4-7n-7e, Lincoln County, was drilling in red shale at 12,100 ft.

Richard W. Norton, Jr., 3 L. N. Dantzler Lumber Co., 10-4s-10w, Stone County, was preparing to spud.

MICHIGAN

Crude Production On Upward Trend

SAGINAW, Mich. — Michigan oil fields are making progress toward the federal quota in excess of 63,000 bbl. a day, production figures from the Oil and Gas Association of Michigan revealed today. The February average was 57,879 bbl., a gain of about 250 bbl. a day resulting for new Allegan production and about 275 bbl. a day more from wells in the Fork-Mecosta sector, while other fields remained practically stationary.

Oil men were watching two developments at the week's end, one a test in Leroy Township, Osceola County, 3 miles north of the state's biggest field—Reed City—and the other a Traverse producer in Bay's Kawkawlin field.

Chippewa Oil Co. reported 30 bbl. the first hour in its Leroy Township test in Section 31. The pay was in the Monroe at 3,682 ft. Interest was added by the fact that Ohio Oil Co. recently developed another wildcat in Osceola's Cedar Township, midway between Reed City and Evart fields, which was included in the past week's completions record, showing its natural production at 732 bbl. a day.

Gulf reported approximately 150 bbl. of oil from a surprise flow at 2,137 ft. in its 1 Gouley, Section 33 of Kawkawlin. Most Kawkawlin production comes from the Dundee around 2,800 ft.

MICHIGAN COMPLETIONS

Gladwin County, Beaverton Township: Sun Oil Co. 1 Marble, E½ SW SW 17-17n-2w, wildcat, dry, T.D. 1,564 ft.

1 Lobdell, NE NE NE 16-19n-14w, dry.

Lake County, Sauble Township: Louis Rose T.D. 2,166½ ft.

Missaukee County, Aetna Township: Gordon Oil Co. et al 1 Wing, S½ SW SE 26-22n-6w, flowed 235 bbl. by heads first 10 hr., T.D. 3,824 ft.

Montcalm County, Richland Township: E. C. Dailey 1 Foote communitized, SE SE SW 18-12n-5w, dry hole, T.D. 1,234 ft.

Osceola County, Cedar Township: Ohio Oil Co. 1 Zimmerman, S½ NE SE 28-18n-9w, wildcat, est. 732 bbl., T.D. 3,834 ft.

Osceola Township: Sun Oil Co. 1 Wickerham et al, N½ NE NE 28-18n-8w, 194 bbl. natural first 15 hr., T.D. 3,775 ft.

Van Buren County, Geneva Township: C. F. Clapsaddle Drilling Co. 1 Dahl & Putnam comm., SW SW NE 14-1s-16w, wildcat, dry, T.D. 1,113 ft.

Wexford County, Clam Lake Township: Freeman Oil Co. 1 Lindstrom, S½ SW NW 23-21n-9w, wildcat, dry, T. D. 4,081 ft.

CANADIAN FIELDS

Extension of North Turner Valley Field Indicated

CHATHAM, Ont.—Prospects for extension of the North Turner Valley producing area toward the northwest were improved when Bonaventure Royalties 1, LSD 16, 24-21-3w5, got the Kootenay formation, overlying the Madison limestone, at 9,030 ft. Location is approximately 2 miles north and 1 mile west of Atlas-British Dominion 2, most northerly producer.

In the southwest extension, Brown Oil Corp. 6, LSD 15, 5-18-2w5, got the cardium sandstone marker at 5,920 ft., some 5 ft. higher than Northwest-Hudson's Bay 8 a quarter mile to the northwest, which finished a good producer.

Devonian Test 1, LSD 2, 25-19-3w5, got the Home sand at 6,680 ft. and is deepening. Objective of the test is the Devonian limestone, below the Madison.

Armelgra Test

In southwestern Alberta, Imperial-Armelgra 1, LSD 16, 19-13-13w4, has been plugged back from the Madison limestone and is waiting for pump to test oil shows in the Ellis between 3,100-24 ft. Swabbing test of this horizon indicated 15 bbl. daily with some water.

Tests in the Foothills

Several interesting tests in the Alberta foothills are making progress. In the Ram River-Clearwater area west of Rocky Mountain House, Ram River Oils 2, LSD 8, 1-37-11w5, is moving equipment to test shows of light crude between 4,250 and 4,340 ft. Farther south, on the Walton Creek structure, Home Oil-Anglo Canadian 1 joint test, LSD 3, 12-33-8w5, is practically rigged. In the Wildcat Hills area, Imperial-Wildcat Hills 1, LSD 16, 30-27-5w5, has derrick up and is installing equipment. In the Jump-

(Continued on Page 367)

APPALACHIAN FIELDS

Crude Stocks Continue to Decline in Eastern Areas

PITTSBURGH, Pa.—Several fair gas wells were added last week in Southwest Pennsylvania but no new oil either in Pennsylvania or West Virginia. While awaiting applied methods to stimulate search for Penn Grade oil either by an advance in crude or a blanket exception permitting closer drilling, crude stocks are being drawn on as refinery demand continues in excess of production. The time lag between starting a program and the resultant production from it, suggests still further depletion of stocks before any improvement could develop. The time for remedial action is now.

During the past week in the lower eastern fields, 18 completions were reported of which 4 were dry, 9 gas wells and 5 oil producers with a daily initial of 253 bbl.

(Field completions in next week's issue)

SOUTHWEST PENNSYLVANIA

There was a fair gas well in Armstrong County, another in Washington County and the best in Greene County where the Carnegie Natural Gas Co. brought in a 3,000,000 cu. ft. gas well in Washington Township from the Fifty Foot sand.

Fayette County.—On Chestnut Ridge in South Union Township, New Penn Development Co., Wm. E. Snee et al reached 7,271 ft. in Brown shale in 2 Indian Creek Coal Co. Peoples Natural Gas Co. reached 6,842 ft. in 1 Walters and had a crooked hole. It was shot at 6,834-42 in an attempt to straighten it and is being cleaned out.

Westmoreland County.—On Laurel Ridge in Ligonier Township, New Penn Development Co. et al has all the pipe on the ground and will start casing 1 Beck this week. The bottom, 7,726 ft., is nearing the Onondaga lime.

Maryland Wildcat.—W. E. Snee et al are drilling at 7,154 ft. in 1 Speicher on the Accident dome in Garrett County and in dark limey shale since 7,057 ft.

(Field completions in next week's issue)

WEST VIRGINIA

The three deep tests in the southern part of West Virginia, all made progress during the week. In McDowell County, Godfrey L. Cabot, Inc. reached 5,858 ft., on the John Gilbert farm in Browns Creek district. On the Watts Land Co. Cabot is drilling at 5,986 ft. in the Oceana district, Wyoming County. In the Marsh Fork district, Raleigh County, Columbian Carbon Co. is drilling at 6,046 ft. on the Rowland Land Co.

In Tucker County, the Ohio Oil Co. is drilling below 2,000 ft. in the most eastern test on the Kaemmerling tract in the Dry Fork district.

(Field completions in next week's issue)

Kansas Fields

(Continued from Page 355)

Arbuckle at 4,313-17 ft. and flowed 125 bbl. of oil into the pits after a second treatment of 2,000 gal.

(Field completions in next week's issue)

NEBRASKA

ST. JOSEPH, Mo.—R. L. Ferguson and Edwin S. Towle cored oil stains in their 1 Della Ehbauer, NW NW NE 2-2n-15e, Richardson County, Nebraska, but the Hunton lime was tight and operators could not say whether they had a producer in the region some two miles southwest of the Barada pool. They found Mississippi lime between, 2,050 ft. and 2,058 ft. and the top of Hunton lime at 2,407 ft. The Hunton ran some 12 ft. higher than the same horizon in the old I.T.I.O. 1 Bankers Life well which was drilled about ½ mile still farther southwest. Ferguson and Towle took two cores and were preparing to take a third.

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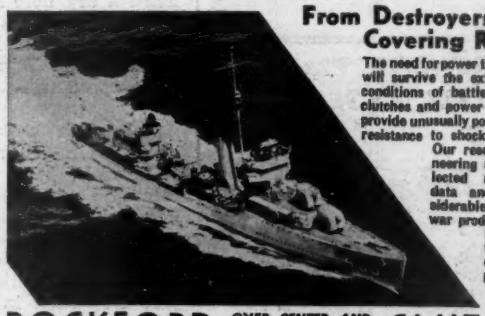

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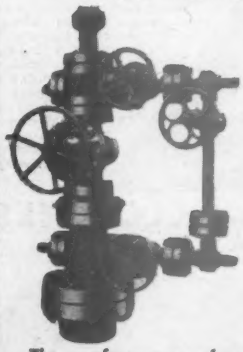

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Among the Drilling Contractors

W. G. Ray, Fort Worth, Tex., contractor, has been awarded drilling work on Southern Production Co.'s 2 Frost Lumber Co., C NE 7-11n-15w, Logansport pool of De Soto Parish, Louisiana.

Harbar Drilling Co., Wichita, Kans., has received contract for Sinclair Prairie Oil Co. 1 Matthews, SW NE SE 28-6-20w, 4 miles south of the Ray pool in Rooks County, Kansas.

McQueen & Clevenger, Fort Worth Tex., are nearing the Permian pay found in the Wasson pool in the wildcat they are drilling for Humble Oil & Refining Co. in southwestern Yoakum County, Texas. The test is scheduled to go 7,500 ft., and is now drilling at about 5,000 ft.

S. C. Herring, Abilene, Tex., finished a dry hole for Fain & McGaha near Truby, Jones County, Texas, and was moving in for a 2,600-ft. test north of the Wimberly pool for the same operators.

Helmerich & Payne, Inc., will use its tools in drilling Falcon-Seaboard 1 Newfelt, in C NW SE 15-22-3w, Harvey County, Kansas. Helmerich & Payne is a partner in the deal.

W. G. Ray has drilling contract on Southern Production Co. 2 Frost Lumber, a location in NE 7-11n-15w, De Soto Parish, Louisiana, on a 640-acre unit in the Logansport pool.

Crone & Gracey Drilling Corp., Houston, Tex., has a contract to drill 2 Hotard, in the Long Lake field, La Fourche Parish, Louisiana, for Shell Oil Co., Inc. It also has the contract, for Shell, on 7 R. E. K., in the Gibson field, Terrebonne Parish, Louisiana. This contractor recently finished an unsuccessful workover of Gulf Refining Co. 1 Delta Securities Co., discovery well of the Bayou Couba field, in St. Charles Parish, which was abandoned.

J. C. Collins, Grand Rapids, Mich., has contracted to drill Dapar Oil Co. 1 Harry Stebbins, NW NE NE 3-4n-12w, in Allegan County, Michigan.

Golding-Farris Drilling Co., Houston, Tex., will drill 1 Levy, a semi-wildcat in Jackson County, Texas, for W. Stewart Boyle et al. It has set surface pipe and is drilling ahead on 3 Bonnot, in the North La Ward field, Jackson County, Texas. It is fishing for twisted-off drill collars at 4,400 ft. in 1 Clara Driscoll, a wildcat test being drilled for Stanolind Oil & Gas Co., 5 miles northwest of the Fitzsimmons field in Duval County, Texas.

General Geophysical Drilling Co., Mount Pleasant, Mich., has contract for Ohio Oil Co. 1 East Jordan Lumber Co., C W½ NW SE 3-30n-6w, Antrim County, Michigan.

Groover & Rose, Albany, Tex., were starting a partnership test with Jones & Stasney of the same city in the Avoca area of northeastern Jones County, Texas. They hope to extend the producing area ¾ mile in going to 3,300 ft.

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PERSONALS

HOLBROOK THAYER ASHTON

Lubrite Manager Has Served W.P.R.A. Board 25 Years

HOLBROOK THAYER ASHTON, general manager of the Lubrite Division, Socony-Vacuum Oil Co., Inc., this year rounds out his twenty-fifth anniversary as a director of the Western Petroleum Refiners Association which held its annual meeting this week at Kansas City, Mo.

Mr. Ashton's career in the petroleum industry started September 13, 1913, when he became assistant engineer of the Columbus Gas & Fuel Co., which formed the nucleus of the Ohio Cities Gas Co. The latter concern subsequently became the Pure Oil Co.

His interest turned to natural gasoline in 1916 and a year later, in collaboration with C. B. Watson, he designed and constructed one of the largest compression-type natural-gasoline plants in existence at Dawes, W. Va.

He was sent to Tulsa in 1918 as general superintendent of Pure Oil Co. refineries at Cushing and Ardmore, Okla. It was then that he became a director of the W.P.R.A. and started his continuing service record on the board of that organization. Three years later he was made division manager responsible for the operation of the refineries.

In 1922 Mr. Ashton became vice president and general manager of the Lubrite Refining Co., St. Louis, Mo., and supervised conversion of this lubricating oil refinery to a gasoline skimming and cracking operation. He collaborated in an improvement of the Fleming cracking process.

After working out an affiliation with Vacuum Oil Co., effective September 30, 1929, he became president and general manager of the continuing Lubrite Refining Corp.

One of the first successful vapor-phase cracking units was built at the Lubrite refinery after long experimental and development collaboration between Mr. Ashton and C. L. Pratt.

He served on several P. & C. committees during NRA and is active on PAW committees serving in the current emergency.

A conference room adjoining his office at St. Louis is the gallery containing 335 autographed photographs of men prominent in the oil industry, all personal friends. Hobbies are golf, squash, fishing and chess.

He married Miss Frieda Alexander of Columbus, Ohio, June 15, 1918. They have one son, H. T. Ashton, II.

Capt. J. F. Lucey and Mrs. Lucey, who are wintering at Palm Springs, Calif., recently were hosts to Mr. and Mrs. **Thomas A. O'Donnell**. Mr. O'Donnel, organizer of the old California Petroleum Co., Red Star Petroleum Co., Petroleum Midway Co. and others, subsequently sold to Texas Co., was the first president of the A.P.I.

C. P. Watson

C. P. Watson, vice president of Seaboard Oil Co. and for the past year vice president of Oil Producers Agency of California, has been elected president to fill the unexpired term of **Lawrence Vander Lock**, who recently resigned to accept the appointment as director of production for PAW District 5.

R. R. Shinn, general superintendent of the San Joaquin division for General Petroleum Corp., recently completed 30 years' service with the company in California, Texas, Louisiana, and Mexico.

B. E. Devere, president of Pathfinder Petroleum Co.; **J. H. Lewis**, president of Sunset Oil Co., and **C. B. Limbocker**, sales manager of Hancock Oil Co., were recently elected members of the board of the Independent Refiners Association of California.

Sherman L. Pease, formerly with Royal Dutch Shell subsidiaries in

Trinidad and Rumania; **C. H. Harrison**, United British Oilfields of Trinidad; **Phillip Gordon**, Kern Trinidad Oilfields, Ltd., and **Charles Bridgewood**, U.B.O.T., were among oil men from foreign countries attending the March meeting of the Los Angeles, Calif., chapter of Nomads.

Gus Strauss, assistant director of the gas-utilities division of the Texas Railroad Commission since early 1940, has been appointed director, effective immediately. He is president of the Guadalupe Firemen's Association and has served 4 years as president of Catholic State League of Texas.

George Wessler, Jr., Arlington, Tex., has been promoted to a captain in the Amy Air Forces in Australia. Captain Wessler, a geophysics engineer, had been employed by Standard-Vacuum Oil Co. in the Dutch East Indies for 3 years before the outbreak of the war, was in Sumatra when war broke out and went to Java to enlist with the U. S. Army. He is on technical assignment.

W. A. Paddock, one of the earliest operators in the Humble and Spindletop oil fields, Texas, is general chairman of the campaign being conducted by the Harris County Chapter of the American Red Cross to raise the chapter's quota of $598,500. **W. N. Finnegan, Jr.**, public relations director

of Humble Oil & Refining Co., Houston, is associate chairman, in charge of the industral, commercial, and professional division. **J. H. Grant,** vice president of Houston Lighting & Power Co., is publicity chairman. Oil companies with headquarters in Houston are among large contributors to the fund.

John Hill, geologist of Midland, Tex., formerly with Baroid Well Logging Service, has joined the geological staff of Union Oil Co. of California's Midland division headquarters.

Verl L. Elliott, controller of the Atlantic Refining Co., Philadelphia, Pa., has been named to two important committees of the Controllers Institute of America, the committee on cooperation with the Treasury Department and the committee on eligibility standards.

Donald D. Utterback, on military leave of absence from his civilian post as geologist for the Texas Co. at New Orleans, La., has been promoted to a captaincy. He entered service July 7 as a first lieutenant in the reserve corps.

Brian Orchard Lisle, petroleum economist and writer, has been commissioned a second lieutenant in the Army Air Forces, having graduated from the officer candidate school at Miami Beach, Fla.

Dwight M. Tedford, production foreman for Carter Oil Co. at Trees, La., has been given a 30-year service award.

Fred J. Hill, scout and landman who recently joined Phillips Petroleum Co. has been assigned to the Houston, Tex., office of the company

J. W. Hamilton, who recently resigned as superintendent of the provincial mining lands division for Alberta, is joining the staff of Home Oils, Ltd., at Calgary, Alta.

J. R. Macdgen, formerly with Gulf Pipe Line Co. at Midland, Tex., has been employed to scout the West Texas district for Skelly Oil Co., with headquarters at Midland. **H. H. Kaderli** has been made land man for Skelly, having been transferred from the scouting department.

Hubert C. Stipp, engineer for the Oil and Gas Division of the Texas Railroad Commission, has been transferred to Midland, Tex., from Big Spring, and will be division engineer in charge of the West Texas district. His transfer consolidates the Big Spring office with the Midland office, resulting in the closing of the former. Mr. Stipp was division engineer at Big Spring for 9 years.

M. G. Cheney, consulting geologist of Coleman, Tex., discussed "Correlation of Pennsylvania Rocks of Texas and Mid-Continent" at last week's meeting of the Tulsa Geological Society.

W. G. Blackwell, New Orleans, La., April 1 will become geologist and petroleum engineer for Sugarland Field Oil Co., Baton Rouge, La. **P. A. Huth** will succeed Mr. Blackwell as New Orleans' district manager of the Minerals Division, Louisiana Department of Conservation.

Dr. Robert J. Watson, Carter Oil Co., Tulsa, addressed the Shawnee Geological Society, Shawnee, Okla., last Friday night. Mr. Carter spent 2 years in Egypt with a seismograph party.

Vern McCrory, in the land department of Smith Petroleum Co., Grand Rapids, Mich., has been assigned to scouting duty, succeeding John Asbury, who died early in March.

William Quigley, scout for the Michigan division, Cities Service Oil Co., will return to Oklahoma late this month for induction into military service.

A. R. McElreath and F. W. Suggett, composing the partnership of McElreath & Suggett, Fort Worth, Tex.,

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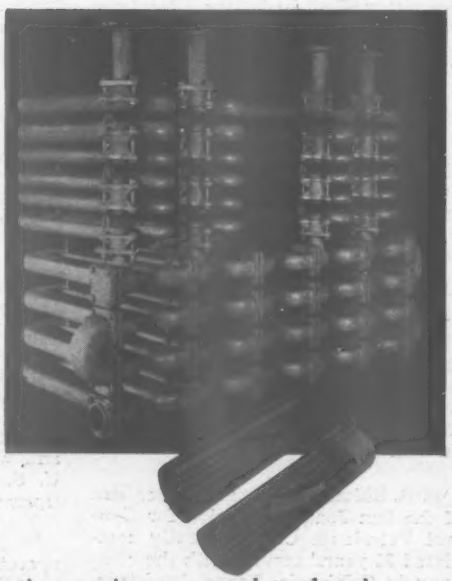

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THE NATIONAL RADIATOR COMPANY
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have announced plans to drill a Smackover lime test in Morehouse Parish, Louisiana, this spring as soon as the swamps have dried out sufficiently to permit moving in rig.

Capt. G. F. Stewart, former producer and contractor in several Michigan fields, has been transferred from Camp Claiborne, Louisiana, to Fort Belvoir, Virginia, to the staff of the officer-command school.

First Lt. L. C. Spier, formerly petroleum engineer for the Division of Minerals, Department of Conservation, La Salle area, Louisiana, has reported for active duty with the U. S. Army. **Luther C. Terrell** succeeds Lieutenant Spier at Jena, La., working out of the Monroe district office.

H. C. Jerome, of the industrial relations department of Carter Oil Co., at Tulsa, has been transferred to Seminole, Okla., as regional personnel manager.

T. M. Martin, vice president and general manager of Lion Oil Refining Co., El Dorado, Ark., has been made a member of PAW district 3 production subcommittee on joint use of facilities.

A. W. Weeks, chief petroleum technologist for PAW in the fourth district, with headquarters in Denver, Colo., is in Montana checking production data in cooperation with producers in Kevin-Sunburst and Cut Bank in connection with applications for exceptions to present spacing plans in those fields.

John E. Mabee, oil producer and contractor of Tulsa, has been appointed to the board of trustees of University of Tulsa, succeeding **L. C. McCollum,** former president of Carter Oil Co., who is moving to New York City to accept a post with Standard Oil Co. (New Jersey).

Harry P. Hohenadel, superintendent of the chemical division of Cities Service Oil Co., Bartlesville, Okla., will be the principal speaker at the regular monthly meeting of the Petroleum Accountants Society of Oklahoma, at Tulsa, Thursday night, March 25. He will speak on "The Chemist in the Modern Petroleum Industry."

Fred A. Jesser, who has been assistant treasurer of United Fuel Gas Co. and associate companies of the Charleston (W. Va.) group of Columbia Gas & Electric Corp. since 1929, has been elected treasurer of the companies to succeed **W. J. Hightower.** Mr. Hightower retains the office of vice president, to which post he was recently elected. Mr. Jesser has been associated with United Fuel Gas Co. since 1917.

UNRETOUCHED PHOTOGRAPH OF

SCALE DEPOSIT IN 12-INCH STEAM LINE

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Market Developments

East Coast

NEW YORK.—All kerosene prices on the East Coast were increased 0.3 cent last week in order to reestablish the normal differential with No. 2 heating oil. This differential, normally 0.5 cent, had shortened to 0.125 cent with the result that No. 2 fuel oil became a more valuable product. This led to an increase in the production of heating oil at the expense of kerosene and contributed to the more severe shortage of the latter product. The increase affected tank-car, tank-wagon and retail prices.

The immediate oil supply picture on the East Coast continued at the lowest level of the year, but the worst, from the standpoint of actual physical discomfort, was believed to be past. Evidence of the severity of the situation was contained in the order extending the gasoline-rationing period which had the effect of reducing the value of base quotas from 3 to 1½ gal. per week.

The long-range aspect is markedly improved. Forecasts issued by the PIWC last week indicated that late 1943 shipments into District 1 will attain record heights. The large war demand which will be supplied from this area will detract from the volume available for civilian consumption, but the latter is expected to be well above the amount available during the past winter.

Mid-Continent

MORE active inquiries appeared in the Mid-Continent refinery-gasoline market this week, indicating, so the trade reported, increased buying for agricultural areas of the northern states where much of the spring plowing and planting is just now starting. The largest rural demand in history for the Middle West farm belt is anticipated by most observers who have checked into the agricultural market.

Meanwhile, shipping instructions from urban customers are steady. Rumors are still circulating that the ban against tank-car shipment of motor fuel into District 1 will be lifted, although OPA's action last week in doubling the valid period of ration coupons in eastern states may delay or nullify previous plans for relaxation of restrictions. The reduced gallonage permitted eastern motorists, however, seemed to confirm reports that motor-fuel supplies in that section are inadequate to meet even the minimum essential requirements and it may yet be that relief will be forced.

Demand for light burning oils has moderated to some extent, although shipping instructions are still being received at rates in keeping with the season. Some refiners are blending more light oils in order to receive the higher gravity prices now prevailing.

Residual fuel oil is in active demand both by industrial consumers and middle western railroads whose requirements are growing more rapidly than the available supply.

Prices for all products, including stabilized natural gasoline, are steady and appear to be on firm ground. Slight weakness is apparent in the unstabilized grades of natural gasoline although offerings are restricted to comparatively insignificant amounts.

Gulf Coast

HOUSTON, Tex. — Although the transportation problem underwent no basic change in the past week, refiners seemed to be viewing conditions a little more cheerfully. Peak of the demand for heating oil in the East and North is believed to have been passed for the year, giving rise to hopes that restrictions on gasoline will be relaxed a little. One particularly optimistic marketer ventured the prophecy that the ban on tank-car shipments of gasoline from this territory to the East Coast would be lifted by the middle of April.

To the surprise of many observers, gasoline stocks of most of the independent refiners in the Gulf Coast area have not risen at a rate to cause uneasiness. Small refiners who have not been able to adjust their operating facilities to meet wartime needs and who lack adequate storage facilities are encountering difficulty, but even these do not face quite so unfavorable a prospect as they did a few weeks ago.

Export movement, details of which are not given out, has been an important factor in preventing inventories from getting out of control in the case of those refineries equipped to make the grades of motor fuel demanded by the Army and Navy.

With the clamor for No. 2 heating oil abating slightly, the shortage of tank cars was not quite so acute, but transportation difficulties continued to be extremely serious. Buyers looking for kerosene were finding the cupboard virtually bare, only occasional cars at scattered points being available. Heavy fuel oil was becoming exceedingly hard to find.

Pacific Coast

LOS ANGELES, Calif. — Gasoline markets continue soft and showed fractional losses last week under depressed sales. In the retail market, sales of premium gasoline continued to show gains, the assumption being that the public feels that as long as it can use only limited amounts due to rationing it might as well use the best.

Sales of gasoline in January were about 33 per cent below last year and it is believed that sales during February will be off about 35 per cent.

In contrast to gasoline, and even though stocks have been building up for the past several weeks, fuel-oil prices continue firm. There has been a marked tendency to accumulate stocks of fuel oil and, in the field, crude-oil stocks, on the assumption that the OPA must eventually permit an increase in prices in order to stimulate production. The directive to refiners to use more heavy crude in order to meet fuel-oil requirements has not met with approval although most refiners are following this order as closely as possible. A report this week revealed that car loadings in California have reached the highest point ever attained, and this indicates that fuel-oil demand will show further gains especially later this year when additional locomotives on order become available. The first delivery on new locomotives will be made in September and demand probably will rise from then on.

A.P.I. REFINERY REPORT

Week Ended March 13, 1943

(Figures in thousands of barrels)

	Dly. crude runs to stills	Stocks: Gasoline	Stocks: Residual	Stocks: Gas oil
Appalachian	142	2,854	506	712
Ind., Ill., Ky.	739	20,699	2,704	3,347
Okl., Kan., Mo.	349	7,456	1,367	1,506
Censored area*	1,585	39,403	9,646	14,009
Rockies	67	2,081	533	352
California	677	20,786	53,487	11,187
Total 3-13-43	3,579	93,279	68,243	31,113
Total 3-6-43	3,626	92,845	68,762	31,668
Total 3-14-42	3,568	109,281	84,730	32,042

Note: Refinery runs and stocks for week ended March 20, 1943, appear on Trends page, unless unavoidably delayed.

*Reports combined on East Coast, Texas Gulf, Louisiana-Arkansas and Inland Texas at request of PAW.

CRUDE-OIL STOCKS

(Bureau of Mines Estimate)

Week ended:	Bbl. of crude*
March 13, 1943	236,655,000
March 6, 1943	235,686,000
March 14, 1942	262,063,000

*Excludes unrefinable California stocks.

Refinery Prices

(Prices as of March 23)

Quotations are f.o.b. plant in cars and in cents per gallon except where otherwise noted. They are exclusive of the federal excise taxes of 1.5 cents a gallon on gasoline and 4.5 cents a gallon on lubricating oils, and do not include marine lighterage charges.

REFINERY GASOLINE

Octane (A.S.T.M.):	†80	74-76	72-74	68-70	63-66
Mid-Continent*	.....	.....	5.875-6.000	.....	5.500-5.625
Pennsylvania	.....	6.750-7.000	.....	.....	.....
Gulf Coast‡	6.00-6.50	.....	§5.750-6.250	§5.750-6.250	§5.250-5.750
Northeast Coast	9.80	.....	9.2	9.2	.....
California	.....	6.125-6.500	6.000-6.125	5.500-6.000	5.000-5.250

*Basis Group 3. †1939 C.F.R. (research method). ‡Integrated companies restricted to lowest prices. §Unleaded.

KEROSENE AND NO. 1 FUEL OIL

Gravity:	46	45	42-44	41-43	38-40
Mid-Continent*	.....	.....	4.500	4.375	.....
North Louisiana	.....	.....	.....	4.500-4.750	.....
Pennsylvania	6.250-6.625	6.125-6.250	.....	.....	.....
California	.....	.....	.....	4.500-5.500	4.250
Northeast Coast	.....	.....	.....	6.80	.....
Gulf Coast	.....	.....	.....	3.875	.....

*Basis Oklahoma Group 3.

TRACTOR, DIESEL, AND BUNKER FUEL OIL

Specifications:	46-48° G.	24 D.I.	48-52 D.I.	58 & above	Diesel bunkers	Residual Bunker C§
Mid-Continent*	4.125	.....	.....	.....	.....	$0.80-1.27
California	.....	2.750-4.000	.....	.....	†1.35-1.45	0.85-1.00
Gulf Coast	.....	.....	4.000	4.125	1.45	0.85-1.27
Northeast Coast	.....	.....	.....	6.800	2.780	1.65-2.07
North Louisiana	.....	.....	.....	.....	.....	0.80-1.27

*Basis Oklahoma Group 3. †10-14° gravity. ‡Pacific Specification 200. §Gravity range.

FURNACE OIL, GAS OIL, FUEL OIL

	No. 2	No. 3	No. 5	No. 6
Mid-Continent*	3.625-3.750	3.500-3.625	$0.85	$0.80
Pennsylvania (West)	5.875-6.125	5.875-6.000	†5.250-5.500	.....
Northeast Coast	6.7	6.7	1.95	1.65
Pacific Coast	5.5	5.5	‡0.80-95	§0.80
Gulf Coast	3.875-4.0	.....	1.65	0.85

*Basis Oklahoma Group 3. †36-40 gravity fuel. ‡Pacific Specification 300. §Pacific Specification 400.

NATURAL GASOLINE

Grades:	26-70	18-55
Oklahoma (Group 3)	3.875	4.650
North Texas	3.500	4.200
North Louisiana	3.625	4.350
California	4.875	5.500

LUBRICATING OILS

Bright and Steam Refined

OKLAHOMA (Group 3)—		
200-210 D, 10-25		27.00
150-160 D, 0-10		23.00
120-125 D, 0-10		22.00
Stea refined:		
600 dark green (untreated)	9.00	9.50
PENNSYLVANIA—		
Bright Stocks (Pennsylvania Grade No. 6 color, 140-150 at 210, 545-550 flash)		
10 pour point		30.50
15 pour point		29.50
25 pour point	25.00	28.00
Steam refined:		
600	15.00	16.00
650	15.50	16.50
600 flash	16.00	17.50
630 flash	17.00	17.50

Neutral Oil

(Vis. at 100° F. except Pennsylvania and color N.G.A.)

OKLAHOMA (Group 3)—	
0-10 pour point:	
200-3	15.00
300-3	18.00
500-3	19.50
600-3	20.00

Note: Viscous neutrals, 10-25 pour, quoted 0.5 cent under 0-10 oils.

Neutral Oils

CALIFORNIA—		
Pale Oils:		
200-2½-3	7.00	7.75
400-3-4	7.25	8.00
600-3-4	8.75	11.00
Red oils:		
200-4-5	7.00	7.75
400-5-6	9.00	11.00
500-900, 5-6½	9.25	11.25
GULF COAST—		
Pale oils:		
200-3	8.50	8.75
300-3	9.00	9.25
500-3½	9.75	10.00
750-3½	10.00	10.25
2,000-4	10.50	10.75
3,000-4	12.25	12.50

PENNSYLVANIA—

150 vis. at 70° F., 3 color, 400-405 flash:	
Zero pour point	37.50
10 pour point	36.50
15 pour point	35.50
25 pour point	30.00
200 vis. at 70° F., 3 color:	
Zero pour point	39.50
10 pour point	38.50
15 pour point	37.50
25 pour point	32.00

WAX

(Cents per pound)

OKLAHOMA (Group 3)—	
124-126 (A.m.p.) w.c. scale	4.250
PENNSYLVANIA (Inland refineries)—	
122-124 (A.m.p.) w.c. scale	4.250
124-126 (A.m.p.) w.c. scale	4.250
NEW YORK—	
Wax in bags fully refined:	
130-132 (A.m.p.) wax	5.850
133-135 (A.m.p.) wax	6.150
Crude scale:	
124-126 (A.m.p.) w.s.	4.250
124-126 (A.m.p.) y.s.	4.250

TANK-WAGON PRICES IN 50 CITIES

(Gasoline prices based on regular grades, tax included, undivided dealer)

ATLANTIC AND NEW ENGLAND

(Socony-Vacuum Oil Co., Inc., and Atlantic Refining Co.)

	Dealer tank wagon	Combined tax	Kero tank wag
Baltimore, Md.	15.95	5.50	10.20
Boston, Mass.	14.90	4.50	9.80
Burlington, Vt	16.90	5.50	10.10
Buffalo, N. Y.	16.20	5.50	10.60
Dover, Del	16.70	5.50	12.00
Hartford, Conn.	15.60	4.50	9.70
Manchester, N. H.	17.30	5.50	10.80
Newark, N. J.	15.20	4.50	9.70
New York, N. Y.	16.10	5.50	9.80
Philadelphia, Pa.	16.20	5.50	11.65
Pittsburgh, Pa.	16.70	5.50	12.00
Portland, Me.	16.30	5.50	9.90
Providence, R. I.	15.00	4.50	9.60
Washington, D. C.	15.20	4.50	11.00
Average 14 cities	16.03	5.14	10.49

(All prices undivided dealer basis.)

CENTRAL

(Standard Oil Co. of Indiana, Standard Oil Co. of Ohio, Continental Oil Co., and Texas Co)

	Dealer tank wagon	Combined tax	Kero tank wag
Chicago, Ill.	13.40	4.50	10.30
Cleveland, Ohio	15.00	5.50	*9.00
Dallas, Tex.	13.00	5.50	7.00
Des Moines, Iowa	14.40	4.50	9.80
Detroit, Mich	14.40	4.50	9.80
Fargo, N. D.	16.90	5.50	11.30
Huron, S. D.	16.30	5.50	10.70
Indianapolis, Ind	15.70	5.50	9.80
Little Rock, Ark.	17.50	8.00	10.00
Milwaukee, Wis.	16.10	5.50	10.50
Minneapolis, Minn.	15.40	5.50	10.30
Omaha, Neb.	15.40	6.50	9.80
Tulsa, Okla.	16.50	7.00	8.50
Wichita, Kans.	12.70	4.50	8.00
Average 14 cities	15.15	5.57	9.61

*Includes 1-cent state tax.

SOUTHEASTERN

(Standard Oil Companies of New Jersey, Kentucky, and Louisiana)

	Dealer tank wagon	Combined tax	Kero tank wag
Atlanta, Ga.	18.90	7.50	*11.50
Birmingham, Ala.	18.50	8.50	9.00
Charleston, S. C.	18.95	7.50	
Charleston, W. Va.	19.25	6.50	13.30
Charlotte, N. C.	20.10	7.50	11.30
Jacksonville, Fla	18.90	8.50	9.50
Jackson, Miss.	17.50	7.50	†9.00
Louisville, Ky.	16.50	6.50	8.50
Memphis, Tenn.	17.90	8.50	10.50
New Orleans, La.	17.75	8.50	*10.00
Norfolk, Va.	17.45	6.50	12.00
Average 11 cities	18.34	7.50	10.46

*Includes 1-cent state tax.
†Includes ½-cent state tax.

MIDWESTERN

(Continental Oil Co.)

	Dealer tank wagon	Combined tax	Kero tank wag
Albuquerque, N. M.	17.50	7.50	10.00
Boise, Idaho	20.10	8.50	16.50
Casper, Wyo.	17.00	5.50	12.00
Denver, Colo.	14.50	5.50	11.00
Helena, Mont.	17.00	6.50	13.00
Phoenix, Ariz.	18.50	6.50	12.50
Reno, Nev.	17.50	5.50	13.50
Salt Lake, Utah	18.50	6.50	14.50
Average 8 cities	17.58	6.25	12.88

PACIFIC COAST

(Standard Oil Co. of California)

	Dealer tank wagon	Combined tax	Kero tank wag
Portland, Ore.	17.00	6.50	13.50
San Francisco, Calif.	14.50	4.50	11.50
Seattle, Wash.	17.00	6.50	13.50
Average 3 cities	16.17	5.83	12.83
Average 50 cities	16.55	5.96	10.78

Equipment Progress

Edward Valve Awarded Maritime "M" Pennant

The Maritime "M" pennant and labor merit insignia, highest production honors of the U. S. Maritime Commission, have been awarded to Edward Valve & Manufacturing Co., Inc., East Chicago, Ind.

First purely Chicago area company to receive the award, the Edward company has been building cast and forged-steel valves for the Maritime Commission ships since the inception of the commission's "C" type shipbuilding program in 1938. Well over 90 out of every 100 cargo ships, tankers and other steam-propelled Maritime Commission ships use Edward valves.

Presentation ceremonies were held in the plant on March 13.

Varec Completing Seventh Addition to Factory

Due to the expansion program, instituted by Frank V. Long, Vapor Recovery Systems Co. of Compton, Calif., manufacturer of "Varec" tank equipment and safety devices, is completing its seventh addition to its main factory since Pearl Harbor. The new addition, which is 5,000 sq. ft., will house the assembly and production line. The "Varec" policy of manufacturing all parts in "Varec" approved equipment under one roof is now in operation. This greatly facilitates keeping production schedules on time.

Ohio Injector Co. Gets White Star for Pennant

Ohio Injector Co., Wadsworth, Ohio, first member of the valve industry to receive the Army-Navy "E" award and pennant for high achievement in the production of war goods, not only has had its award renewed for continued high achievement in the production of war goods, but now has had added to it the white star.

Bowser Gets Production Star

S. F. Bowser & Co., Inc., Fort Wayne, Ind., has again been honored by the Army and Navy by being awarded the 6-month production star. The company was awarded the Army-Navy "E" last July.

Trade Literature

Vickers, Inc., 1400 Oakman Boulevard, Detroit, Mich.—A new 20-page bulletin describing the company's hydraulic oil-well pumping unit. The booklet is profusely illustrated, and contains helpful selection data for the units.

Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.—A new 96-page booklet, entitled "Wartime Conservation," which contains recommendations by Westinghouse engineers for selecting, applying and using electrical equipment so as to achieve the best possible output with the greatest saving in critical materials. It covers up-rating of motors, thermal temperature loading of transformers, industrial network systems, line equipment and materials, and gives tips on saving and salvaging materials.

South Bend Lathe Works, South Bend, Ind.—Bulletin H-3, "The Installation and Leveling of the Lathe," which covers the many points which must be taken into consideration when installing lathes so that the most efficient operation can be obtained. Among the subjects described and illustrated are unpacking the lathe, illuminating, floor layout, supporting and securing.

Arklay S. Richards Co., Inc., 72 Winchester Street, Newton Highlands, Mass.—"Thermocouples and Their Accessories," a new catalog and engineering data book designed to acquaint the pyrometer user with new developments in industrial thermocouples, providing greater accuracy by proved sensitivity and less interruption by greater ease of replacements.

Among Equipment Men

Bristol Co. Announces Three Changes in Personnel

L. G. Bean has been appointed vice president in charge of engineering and sales for Bristol Co., Waterbury, Conn. Mr. Bean has been serving as vice president and general sales manager since 1939. He became associated with the company in 1920 as sales engineer. In 1935 he became sales manager, later becoming vice president and general sales manager.

L. G. BEAN

H. E. BEANE

E. L. STILSON

Harry E. Beane has been named sales manager of the company. He joined Bristol in 1920, and has served successively as district manager of the Birmingham, Ala., office, district manager of the Pittsburgh district and field sales manager to supervise the activities of the company's branch factories at Chicago, Ill.; Akron, Ohio, and San Francisco, Calif., and supervisor of the work of the company's district managers, sales engineers and service engineers.

E. L. Stilson has been appointed assistant sales manager. He, too, joined the company in 1920, and has served in various capacities. In 1933 he was named manager of Bristol Co. of Canada, Ltd., at Toronto. He was made special sales engineer for the petroleum industry in 1938. Since 1940 he has been associated with the field engineering department.

Harris Retires From Oilwell

Bertram L. Harris, manager of the Bartlesville, (Okla., office of Oil Well Supply Co., and one of the best known oil-field supply men in Oklahoma, retired March 13, following 41 years of active service with his company. He started with Oilwell on March 1, 1902, at the company's Findlay, Ohio, store. Subsequently he managed both the store and the field shop maintained by Oilwell at that point. In 1909 he was transferred to Bradford, Pa., and on December 6, 1915, he moved to Bartlesville.

Classified Advertising

EQUIPMENT FOR SALE

FOR SALE—Approx. 6500 ft. 6⅝" OD 25.20# drill pipe with Reed Full Hole Shrink Grip Tool Joints, A-1 condition. Inquire T. T. Eason and Company, Enid, Okla.

AIR COMPRESSORS, Graders, Road Rollers, Pneumatic Air Tools, other contractors Equipment and Refinery Equipment. Rent or sell. Falls City Sales Company, Box 776, Louisville, Kentucky.

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DEEGEN PIPE & SUPPLY CO.
401 No. Boston
Phone 3-2329 Res. 6-4726
Tulsa, Okla.

GASOLINE PLANT EQUIPMENT FOR SALE

1—10,000 Bbl. Graver Spheroid Gasoline Storage Tank.
2—75 HP Erie City Iron Works Return Tube Boilers.
1—45 HP 125# W.P. F&T Oil Field Type Boiler.
4—10" Griscom-Russell Bent Tube Oil Coils.
2—Braun 144" Open Type Oil Coolers.
1—4' x 14'4" Type Deph Tulsa Boiler Dephlegmator.
1—Southwestern 240-120-B Condenser.
Also miscellaneous pumps, steel tanks, steel buildings, control panel equipment.

MAGNA MATERIAL COMPANY
P.O. Box 1814 Tulsa, Okla.
Phones: Local 2-1188. L.D. 501

EQUIPMENT FOR SALE

FOR SALE: Lufkin pumping unit suitable for 4000' well. Melton Supply Co. Seminole, Okla.

FOR SALE at Seminole, Oklahoma, two steel pumping beams $100.00 each. Cities Service Oil Company, Bartlesville, Okla.

FOR SALE—Bessemer Gas Engines, Compressors and repair parts. Vessels, towers, pumps, Chaplin Fulton regulators, Fisher liquid level controls, vacuum, pressure & temperature recorders, meters, valves, fittings, pipe and other miscellaneous material. GILBERT PIPE & SUPPLY, Electra, Texas.

ROYALTIES

WE BUY & SELL all types of Oil and Gas Royalties. Sales restricted to registered dealers only. Grimes Royalty Co., National Mutual Bldg., Tulsa, Okla.

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CAPITAL SEEKERS—Interested in raising $25,000 or more for a legitimate project should write to AMSTER LEONARD, Fox Theater Bldg., Detroit, Mich.

INCORPORATION

DELAWARE CHARTERS: Powers broad, taxes low. Many of the largest corporations have Delaware charters. Complete service $35. Submitted forms. Chas. G. Guyer, Inc., Wilmington, Delaware.

REAL ESTATE

WINNFIELD, LA.

Center of North Central Louisiana oil activity, invites oil men and oil concerns to make their homes and headquarters at Winnfield.

TOWN OF WINNFIELD
City Hall Winnfield, La.

Canadian Fields

(Continued from Page 356)

ing Pound area, west of Calgary, Shell Exploration-Norman 1, LSD 5, 22-24-5w5, is below 7,046 ft. Southwest of Turner Valley, Sullivan Creek 1, LSD 13, 25-17-5w5, is below 1,364 ft. and close to the Madison limestone, where production is expected. In the Livingston Range area, Royal Sun Petroleums 1, LSD 2, 17-13-3w5, is in limestone formations below 1,105 ft.

Vermilion Operations

Engineers of Cannar Oils, subsidiary of the Canadian National Railways, reached Calgary recently, and have been studying geological and other data preparatory to starting work this spring in the Vermilion field. Contracts have already been let for two groups of five wells each, and an initial program of 50 wells will be started in April. J. M. Penny, geologist for the C.N.R., will have general supervision of operations. The program includes the establishment of a processing plant to clean and condition the heavy crude for railway fuel.

Tax Concessions Asked

Members of the Alberta Petroleum Association have adopted a resolution asking the Dominion Government to extent the tax concessions granted to assist oil development. The resolution asked that depletion allowance to oil companies and royalty-financed compnes be placed on a uniform basis of 33⅓ per cent of gross production, that tax concessions be extended to wells drilled prior to January 1, 1943, and that individuals investing up to $5,000 in wildcatting be allowed income tax deduction up to 40 per cent of any loss involved.

Fraser Valley Prospect

New tests of oil and gas prospects in the Fraser Valley of British Columbia will be undertaken by Surrey Dome Oil & Gas Co., recently incorporated with head office at Vancouver. Directors of the Surrey Dome company are Melvin A. Durland, William R. MacDonald, Frank H. Eyomann, Francis Rochon and William M. Silcox. Oil and gas seepages have been reported in the Fraser Valley area, and some deep tests have been drilled for oil, which in several cases encountered gas approximating a small commercial production at shallow depths. Natural-gas production would find a ready market in Vancouver, New Westminster and adjacent smaller communities.

Saskatchewan Operations

In southern Saskatchewan, Norcanols-Ogema 1, deep test, LSD 4, 24-7-23w2, has spudded and is below 1,166 ft. Imperial-Dahinda 1, LSD 10, 28-10-23w2, is rigged ready to spud.

Crude and natural-gasoline production from all Alberta fields for the week ending March 8 averaged 26,951 bbls. daily compared with 26,825 bbls. daily for the previous week and 29,578 bbls. daily for the corresponding week last year. The daily average included 25,505 bbls. of crude petroleum and 1,160 bbls. of natural gasoline from Turner Valley and 286 bbls. of crude from outside fields.

January Production Figures

Alberta oil production for January totaled 840,613 bbls., including natural gasoline, an average of 27,116 bbls. daily, a decrease in the daily average of 40 bbl. from December and 699 bbls. from January 1942. Natural-gas production in January totaled 5,970,241,000 cu. ft.

Ontario Drilling

Recent completions in the southwestern Ontario fields include one well in the western section, Union Gas 118, Lot 25, Concession 13, Dawn Township, finished at 1,820 ft. with 175,000 cu. ft. daily. In the eastern portions of the natural-gas area there have been 10 completions, of which 6 were producers aggregating 244,000 cu. ft. daily.

Crude-Oil Prices

Representative selected crude prices from all sections of the country appear below:

East Texas	$1.25
Conroe	1.43
Tepetate, Louisiana	1.18
Illinois basin	1.37
Pecos County, Texas	.98
Bradford, Pennsylvania	3.00
Van, Van Zandt County, Texas*	1.08

*No change since 5-21-41.

Gravity Schedules

Top prices include all gravities above grades designated, and low prices include all gravities below grades designated:

Gravity—	Signal Hill, Calif.	Oklahoma, Kansas	Gulf Coast Texas	West Texas*
18-18.9	$0.80	...	...	...
19-19.9	.84	...	$1.06	$0.76
20-20.9	.88	$0.86	1.08	.72
21-21.9	.92	.87	1.10	.74
22-22.9	.96	.89	1.12	.76
23-23.9	1.00	.91	1.14	.78
24-24.9	1.03	.93	1.16	.80
25-25.9	1.07	.95	1.18	.82
26-26.9	1.11	.97	1.20	.84
27-27.9	1.15	.99	1.22	.86
28-28.9	1.18	1.01	1.24	.88
29-29.9	1.20	1.03	1.26	.90
30-30.9	1.23	1.05	1.28	.92
31-31.9	...	1.07	1.30	.94
32-32.9	...	1.09	1.32	.96
33-33.9	...	1.11	1.34	.98
34-34.9	...	1.13	1.36	1.00
35-35.9	...	1.15	1.38	1.02
36-36.9	...	1.17	1.40	1.04
37-37.9	...	1.19	1.42	1.06
38-38.9	...	1.21	1.44	1.08
30-39.9	...	1.23	1.46	1.10
40 and above	...	1.25	1.48	1.12

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